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THE PETROLEUM ENGINEER PUBLISHING COMPANY
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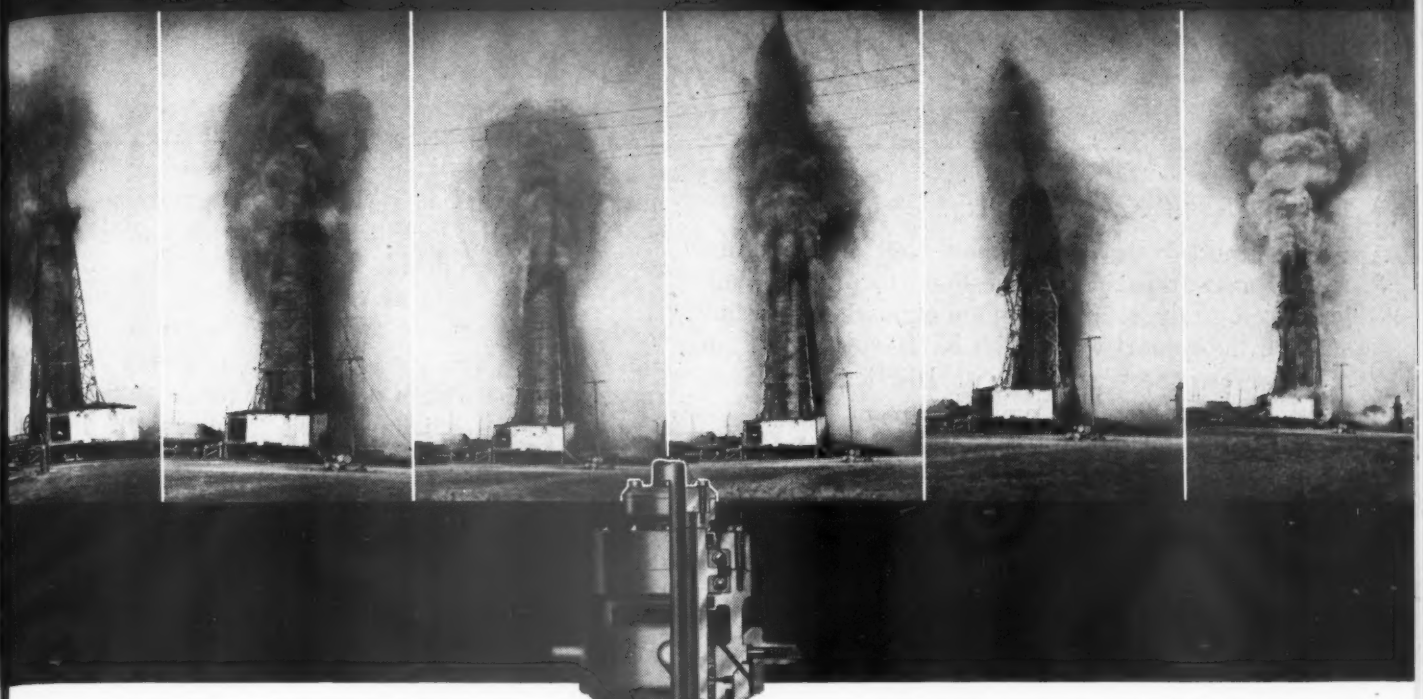

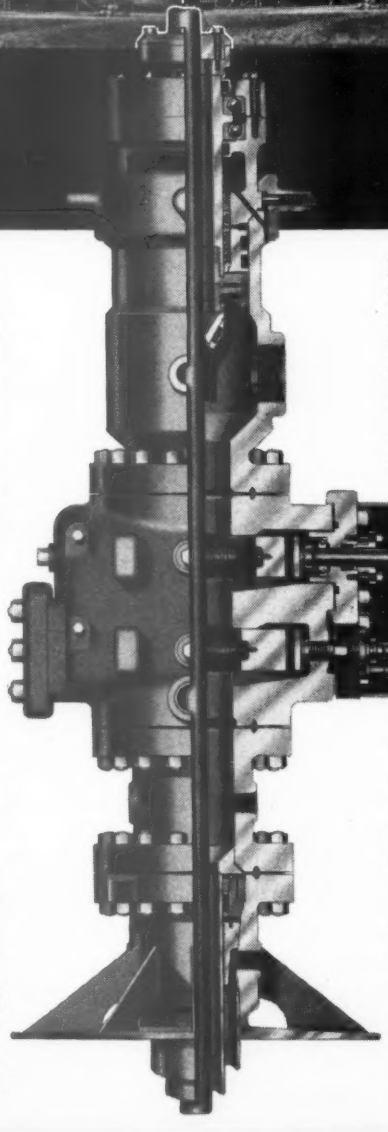

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HIGH PRESSURE DRILLING AND CONTROL EQUIPMENT • FISHING TOOLS THAT EXCEL

The Course of Oil

by K. C. SCLATER

OIL'S SIGNIFICANT ROLE

World oil reserves and how they are handled in the postwar period are destined to play a significant role in the relationship among nations. On this subject, the remarks of Ralph K. Davies, in an address before the Pacific Coast District, American Petroleum Institute, are highly pertinent.

"The idea of an International Oil Agreement springs from a recognition of the fact that in the modern world oil is as indispensable in peace as it is in war. Further, that depending on how the world reserves of this basic commodity are managed it will either enhance our chances for future peace in the world or it will endanger that prospect. Oil, as you know, has in the past both contributed to the maintenance of peace and to the advent of war. As liquid power and black gold its potentialities are great for good or evil, beyond that of any other commodity.

"If there is any one proposition on which the American public is united it is that this country shall, in the future, exercise such vigilance as to the trend of events over the world that we shall not again be called upon to quench fires started in other lands, with the blood of the youth of America. The great lesson which this war teaches us—at such tragic cost—is the fact that whether we like it or not, we are but members of a world family and that if the affairs of that family be not well managed, guilty or innocent, we must suffer with the rest. . . .

"In this management of International affairs there must be skillful treatment of the world economy in many directions. Oil looms clearly as a problem of especial importance. It is for this reason that it has been set aside for individual attention and tackled well in advance—this and the fact that there has been a good deal of initiative displayed in certain quarters. The problem as a whole is complex and difficult in the extreme, of course. It cannot be dealt with all at one time. We must move forward by degrees. The Anglo-American Agreement represents but a first step, but a vastly important one.

"I shall not advert to the industry reception to our first attempt with this treaty. Suffice to say that the differences between Government and industry have been well reconciled in the second draft now under consideration by the various Government departments. The obstacle at the moment centers about the inclusion of an anti-trust immunity clause giving the industry what I believe to be only fair treatment in relation to the anti-trust laws. In essence it provides that when the industry acts in concert at the Government's suggestion in carrying out a Government-approved plan, it shall not thereafter be prosecuted for its act. I cannot say what the outcome will be, but I remain decidedly hopeful.

"Order and stability in International trade in oil is of vital importance to the oil industry in California. The day has passed when the Sierra Nevada range, and the waters of the Pacific are sufficient to protect the oil economy of California from the effects of disorder in the other principal oil sources of the world. Just as isolationism has proved a snare and a delusion in the political sense, so in respect of oil it is a wholly untenable theory. Oil is predominantly international in character. The vast deposits of oil in the Middle East—probably approaching in size those of the United States—and the resources of South America and other principal oil areas, will in postwar commerce have much to do with shaping your California future. The effect may be indirect but it will be real. It behooves you to interest yourselves actively in this prospect. Your oil horizon has broadened vastly in recent years. No longer is it limited to western skies. Today it encompasses the full circle; it is world-wide. You fall heir to a great opportunity, a great challenge, and a great responsibility."

RULING JOLTS INDUSTRY

Already beset with equipment, personnel, and other operating problems, the industry was given a severe jolt by the recent ruling of the New Orleans Court that intangible drilling costs are not deductible in computing income tax. The Internal Revenue Bureau's announcement that oil companies may continue to deduct intangible drilling costs helped to relieve the anxiety that gripped the industry, but it did not remove the harmful effects arising from apprehension over the outcome of this new ruling.

Sudden retrenchment of projected drilling programs has been reported in several very active drilling areas. How severe such scaling down of drilling programs really is and its eventual effect on oil production and in meeting military needs remains to be seen. It could be very serious. At the moment, it does not appear likely that the industry will wait the outcome of an appeal from the court ruling and run the risk of prolonged curtailment of drilling operations and the harmful effects that must ensue. Congressional action will probably be sought for legislation that would clarify and affirm the regulation of the Internal Revenue Bureau under which the industry has been operating. Such action would remove existing apprehension and help provide the needed impetus in drilling.

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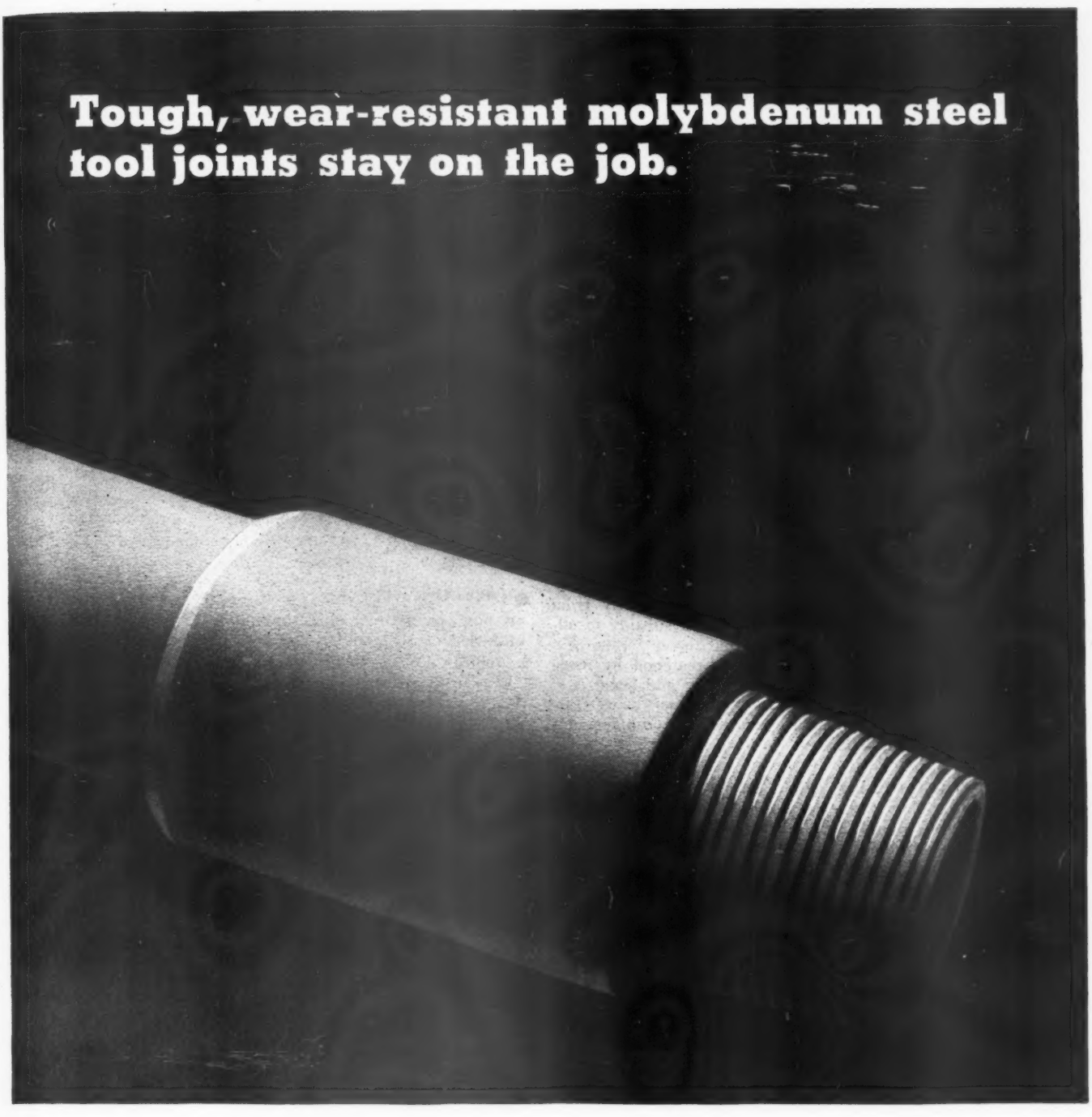

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Scanning WASHINGTON'S OIL HORIZON

MILBURN PETTY

WASHINGTON.—It will be at least 30 days after V-E Day before the full impact of the European war's end is felt by the petroleum industry, but there are some indications of what's to come.

PAW insists the production program will continue as planned, with more drilling as materials and manpower are released by cutbacks in other war industries. Pressure will soon develop for revocation of PAW's well-spacing order, PAO 11.

Transportation situation depends on the navy's need for tankers for transportation and storage in the Pacific; also, for supplying postwar demand in Europe. If there aren't enough boats left over to put back a considerable number into the East Coast run, overland transportation will have to continue at high levels.

Refining operations programs are on the basis of continued all-out production of 100-octane. Charging stock for cat crackers will still be a problem, with the navy taking huge quantities of distillate fuel and with stockpiling of heating oils necessary to avoid a shortage next winter. In addition, there is a large, pent-up civilian demand for kerosine in Europe that President Roosevelt may find it politically wise to satisfy.

Eastern marketers are already clamoring for removal of PAW restrictions that prevent them from importing directly from western refineries and utilizing the government subsidy to offset the extra cost of overland transportation.

But the industry's postwar stability is threatened by more civilian gasoline becoming available with fewer and fewer cars to consume it. Five million cars have "died" since Pearl Harbor. Thin tires and no immediate prospect of replacement threaten to lay up many more.

● **EUROPEAN OIL POLICY PLANNED.** Continuance of the heavy demand on U. S. refineries depends on how long it will take to rehabilitate plants in the liberated areas. Technical oil missions are being trained here to do this job in each country.

Overall policy-making is being done by the European Petroleum Committee, with Ralph K. Davies, deputy petroleum administrator, as chairman and representatives of other agencies and the British as members. An industry advisory committee, known as the European Petroleum Supply Committee, has been set up.

The American mission to study Germany's synthetic oil plants has arrived in Europe. Its report should be helpful in experiments in this country.

● **OIL TREATY.** Most optimistic outlook for the Anglo-American oil agreement now is that it will be kept as a loaded pistol in the top dresser drawer in case some third party attempts a territorial grab before a more comprehensive, multi-lateral treaty is adopted.

State Department has never got over its pique at the industry rejecting the original oil agreement and proposing a substitute. That is one explanation of the State Department dragging its feet in negotiations on the revised agreement. Another factor was the growing sentiment against single-commodity agreements as compared with all-commodity trade treaties. Also, some people in State felt that the immunity provision, which the industry insisted upon, might prompt criticism that the government was opening the door to a cartel. And they had Attorney General Biddle's support in this.

Petroleum will be surely included in discussions at the world-wide trade conference planned by the State Department. Also, there is a possibility of a conference of nations on conservation of petroleum, minerals, and forests. Out of either of these could come the more comprehensive agreement that the State Department seems to favor over the present Anglo-American pact.

● **CANOL WORKERS RETURNING.** Oil workers from Canol are filtering back to U. S. refineries following shutdown earlier this month of the army's oil project in Northwest Canada.

● **GOVERNMENT OIL PROSPECTING.** Already, there is talk in government circles on what can and should be done to assure a domestic oil supply for the next war. One suggestion is for the Interior Department to undertake geophysical work, making results available to help the independent wildcatter. The old favorite tune, "Import and Save Our Own Oil," will be heard again.

● **TIDELANDS.** Secretary Ickes still wants to test the federal vs. state claims to offshore submerged lands, beginning with California. But he found it not so simple as just granting a "public lands" lease and letting the state take it into court. The leasing plan has been held up. Now, Mr. Ickes thinks maybe action by the Department of Justice, affirmatively pressing the federal claim, might be quicker. Meanwhile, a dozen or more quit claim resolutions are pending in Congress. They would declare that the states have title to these submerged lands.

● **OPA COST STUDIES.** OPA's production cost questionnaires are now circulating among the industry, but the question is still unsettled on whether replacement costs will be considered as a factor that might justify an increase in crude oil price ceilings.

Russell B. Brown, general counsel for Independent Petroleum Association of America, has well over a thousand powers-of-attorney from producers to file a formal protest with OPA against crude price ceilings. But he told a Senate committee that he hasn't much hope unless OPA can be compelled by legislative action, or otherwise, to recognize replacement costs. He also asked that percentage depletion be considered an item of cost. And he wants a change in OPA's base period, pointing out that Treasury Department reports show 60 per cent of producers lost money in 1936-39.

Congressman Patman's small business committee has renewed its pressure on OPA for higher crude price ceilings.

OPA and its refining advisory committee, headed by C. L. Henderson, Vickers Petroleum Company, Wichita, Kansas, have differed over whether the refining cost survey should include data on a company's operations in other branches. Refiners say it shouldn't.

● **PUBLIC LANDS LEASES.** Interior Department is considering proposals from the industry that oil and gas leasing rules be changed to liberalize acreage limitations, set a flat royalty instead of a sliding scale, and exclude from acreage limitations all lands optioned for geophysical exploration.

● **ELK HILLS EXTENSION.** Navy is seeking an appropriation from Congress for exploratory drilling in Cole's Levee area, east of Elk Hills Naval Petroleum Reserve in California, to see whether the same structure exists there. California Standard would do the drilling.

● **INTANGIBLE DRILLING COSTS.** Some producers feel that the F.H.E. Oil Company case, in which the New Orleans circuit court held that the Internal Revenue Bureau's regulation permitting the expensing of intangible drilling costs was invalid, might have been an indirect attack on this 25-year-old regulation by the Treasury Department itself. They fear it may foreshadow another move against the depletion allowance as well as the intangible rule. Revenue bureau has said the court's ruling will not be adopted unless upheld by the Supreme Court.

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To catch the initial rush of gas, breaker rings of K & M Hy-Temp Bakelite capable of withstanding temperatures up to 400° F. are placed in the grooves next to the cylinder head.

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To complete the job of providing long, low cost operation, Bridge rings of K & M Super Bakelite are installed in pairs with the Graphitized rings, one Radial and one Bridge ring to each groove. A bronze dowel in each Bridge ring engages the gaps in the Radial ring and prevents lining up of the gaps in both rings.

Next time your rods need packing, use K & M—for less first cost—lower lubricating costs—and elimination of rod scoring.

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National Petroleum Situation

DRILLING PROGRAM LAGS. Well completions for the first quarter of this year were 11 per cent under the quota prescribed by PAW. To meet a program of 27,000 wells this year the industry should have drilled 6,660 wells in the first quarter but completions only totaled 5,938. Wildcat drilling is about 22 per cent under the program for the first quarter. Wells drilling March 31 were 4,100, against 4,400 in December.

Beginning with this issue, charts showing trends of production and demand of crude and refined products will be on a daily average basis instead of monthly totals. Trends of drilling and stocks of crude and refined products will continue to be shown on a monthly total basis.

INCREASED GASOLINE SUPPLY. Marked improvement in gasoline stocks was recorded during March. Storage accumulations in March amounted to about 6,000,000 bbl., reaching a total at the end of the month of 92,225,000 bbl. At present rate of demand this supply is sufficient for 47 days, against 43 days supply a year ago. Last year's stocks were reported by the Bureau of Mines at 79,664,000 bbl. Peak stocks in 1944, on April 30, were 80,851,000 bbl.

PROCESSING EXCEEDS PRODUCTION. Runs of crude to refinery stills in the first quarter were 8 per cent above a year ago. Still runs averaged 4,787,000 bbl. daily against a daily crude output of 4,777,000 bbl. Total crude demand by refineries in March was 150,670,000 bbl., against the month's crude production of 148,900,000 bbl. Since crude oil stocks are shown to have increased about 3,000,000 bbl., it is apparent that about 4,700,000 bbl. of foreign oil was processed by refineries in March.

FUEL STOCKS SHARPLY OFF. Stocks of fuel oil were severely reduced in March, declining to 63,050,000 bbl., against 75,353,000 bbl. a year ago. Efforts to meet the unusually heavy demand for fuel oils are reflected by a decline in the yield of gasoline from crude processed by refineries. The March yield was about 39.2 per cent, against 40.8 per cent in February. At the March rate of demand, stocks of fuel oil constituted about 27 days supply, against 36 days supply a year ago.

PEAK CRUDE OUTPUT. Daily crude output in March averaged 4,803,000 bbl., which is another new peak. Bureau of Mines figures for January reported daily crude output of 4,748,000 bbl., while preliminary estimates for February indicated a daily average of 4,780,000 bbl. The national gain in the first quarter of this year was 8 per cent over a year ago. However, Texas reported an increase in crude output of 14 per cent; California 10 per cent; Oklahoma 13 per cent, and Mississippi 14 per cent.

Comparative Statistics, March, 1945

All figures are computed on a Bureau of Mines basis.*

	March 1945(p)	Feb. 1945(p)	March 1944	This year to date	Last year to date	Per cent change
Wells drilling	4,100	4,055	3,079	4,100	3,079	+33
Total wells drilled	2,028	1,829	1,650	5,938	4,690	+27
Development wells	1,729	1,515	1,360	4,979	3,870	+29
Oil	1,078	931	916	3,077	2,744	+12
Gas	174	165	186	532	412	+29
Dry	477	419	258	1,370	714	+92
Per cent dry	27.6	27.7	19.0	27.5	18.4	+ 9.1
Wildcat wells	299	314	290	959	820	+17
Oil	62	42	37	150	108	+39
Gas	11	13	14	34	25	+36
Dry	226	259	239	775	687	+13
Per cent dry	75.6	82.5	82.4	80.8	83.8	— 3.0
Crude production	148,900	133,830	136,552	429,916	401,220	+ 7
Daily average	4,803	4,780	4,405	4,777	4,409	
Crude demand†	149,780	142,584	143,756	440,140	411,069	+ 7
Daily average	4,832	5,092	4,637	4,890	4,517	
Crude stocks	227,700	224,784	243,296	227,700	243,296	— 6
Days supply	47	45	53	47	53	
Natural gasoline production	9,680	8,520	8,250	27,803	24,036	+16
Daily average	312	304	266	309	264	
Motor fuel production	67,225	62,607	59,350	196,494	174,021	+13
Daily average	2,169	2,236	1,915	2,183	1,912	
Gasoline yield, per cent	39.2	40.8	37.9	40.0	38.6	+ 2.4
Motor fuel demand	61,008	56,259	57,940	182,342	163,662	+11
Daily average	1,968	2,009	1,869	2,026	1,798	
Motor fuel stocks	92,225	86,010	79,664	92,225	79,664	+16
Days supply	47	43	43	47	43	
Fuel oil production	64,130	59,488	59,601	186,036	172,411	+ 8
Daily average	2,069	2,125	1,923	2,067	1,895	
Fuel oil demand	71,536	68,192	65,626	219,302	195,790	+12
Daily average	2,310	2,435	2,117	2,437	2,152	
Fuel oil stocks	63,050	67,856	75,353	63,050	75,353	—16
Days supply	27	28	36	27	36	
Refinery still runs	150,670	135,055	137,902	430,796	398,056	+ 8
Daily average	4,860	4,823	4,448	4,787	4,374	
All refined stocks	231,560	225,106	224,987	231,560	224,987	+ 3
Days supply	44	42	46	44	46	

*Unless otherwise stated all figures represent thousands of barrels.
†Domestic and foreign.

Economic Position of U. S. Petroleum Industry

March, 1945

	Normal	Actual	Per cent of normal
Drilling*** (wells completed)	6,660	5,938	89
Production (daily crude output)	4,920	4,777	97
Refining (daily still runs)	4,940	4,787	97
Stocks (crude and refined)	575,000	459,260	80
Price of crude (per bbl.)	$1.98	$1 22	62

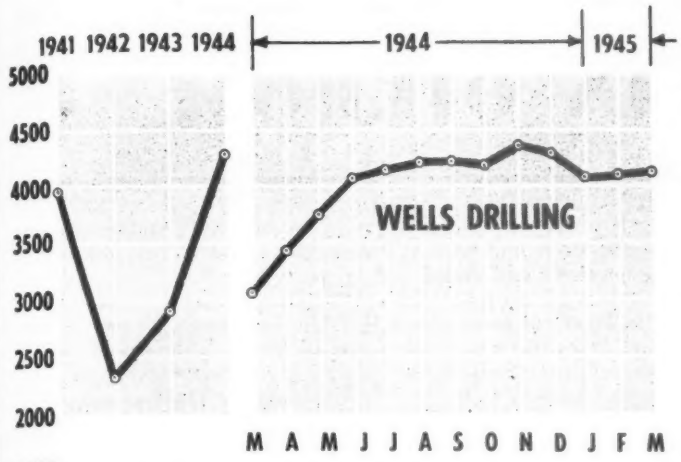
Crude Prices by States for March, 1945

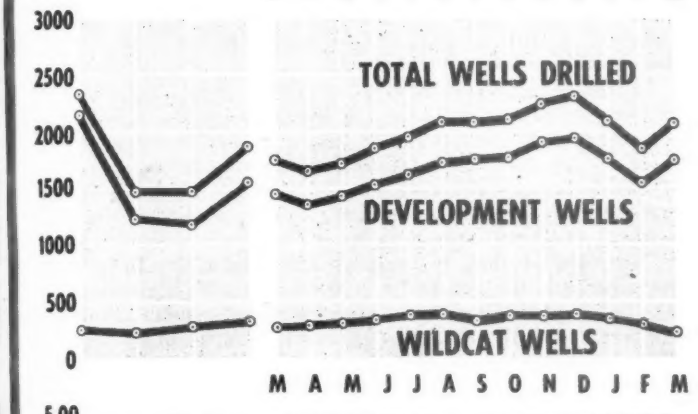
U. S. average	$1.22	Louisiana	$1.20	Basic crude prices	
Texas	1.23	Arkansas	1.25	Oklahoma-Kansas (36 gr.)	$1.17
California	1.07	New Mexico	1.04	Texas Gulf Coast (36 gr.)	1.40
Oklahoma	1.17	Mississippi	1.10	East Texas	1.25
Kansas	1.17	Illinois	1.37	West Texas (36 gr.)	1.04
		Other States	1.89	Calif. Signal Hill (26 gr.)	1.11
				Pennsylvania Bradford	3.00

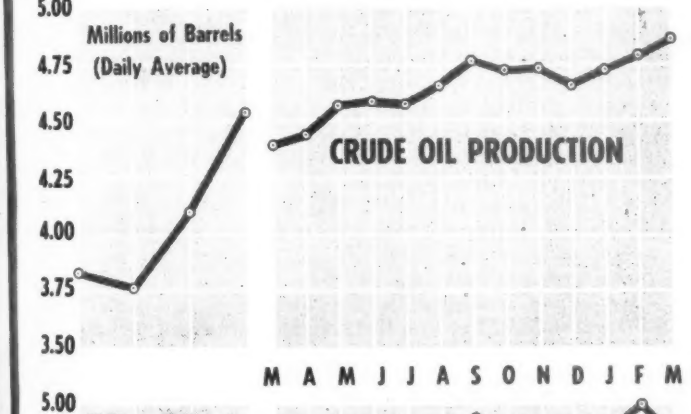
Drilling and Production Statistics by States

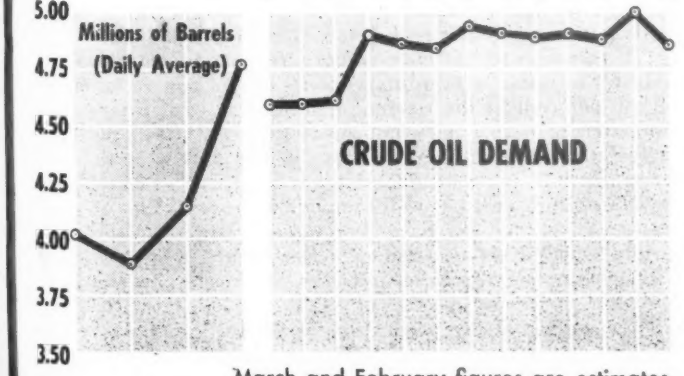
	March 1945(p)	Feb. 1945(p)	March 1944	This year to date	Last year to date	Per cent change
Total wells drilled	2,028	1,829	1,750	5,938	4,690	+ 27
Texas	525	558	444	1,635	1,142	+ 43
California	200	159	157	580	449	+ 29
Oklahoma	171	177	140	543	340	+ 60
Kansas	144	102	177	358	419	— 15
Louisiana	99	67	65	247	159	+ 55
Arkansas	3	11	20	27	53	— 49
New Mexico	43	34	43	118	111	+ 6
Mississippi	27	22	11	75	37	+103
Illinois	105	110	150	384	407	— 6
Other States	711	589	543	1,971	1,573	+ 25
Wildcats drilled	299	314	266	959	820	+ 17
Texas	115	155	79	396	297	+ 33
California	19	14	10	55	38	+ 45
Oklahoma	39	26	29	99	70	+ 41
Kansas	20	26	51	81	114	— 29
Louisiana	16	8	11	40	37	+ 8
Arkansas	1	7	7	12	17	— 29
New Mexico	3	8	8	19	18	+ 6
Mississippi	15	8	7	33	25	+ 32
Illinois	20	14	21	70	75	— 7
Other States	51	48	43	154	129	+ 19
Daily crude production	4,803	4,780	4,405	4,777	4,409	+ 8
Texas	2,190	2,162	1,887	2,171	1,901	+ 14
California	910	895	828	899	821	+ 10
Oklahoma	370	385	333	373	330	+ 13
Kansas	271	248	274	263	273	— 4
Louisiana	355	355	353	354	351	+ 1
Arkansas	81	82	80	81	80	+ 1
New Mexico	105	104	115	104	114	— 9
Mississippi	50	49	41	49	43	+ 14
Illinois	195	217	216	205	218	— 6
Other States	276	283	278	278	278	....

§No change since prices frozen. Prices do not include subsidies.
(p) Preliminary. ***Does not include input wells.

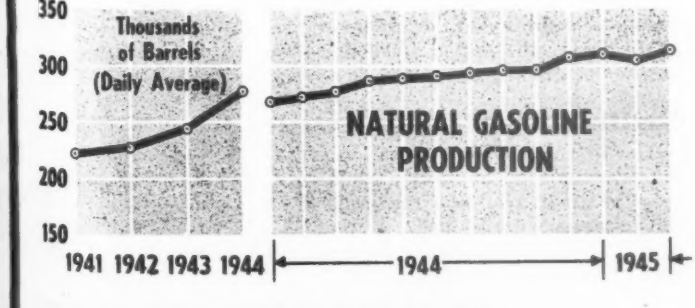


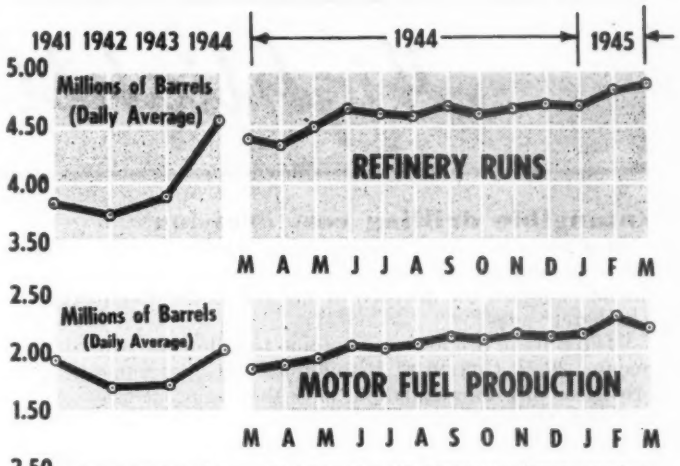


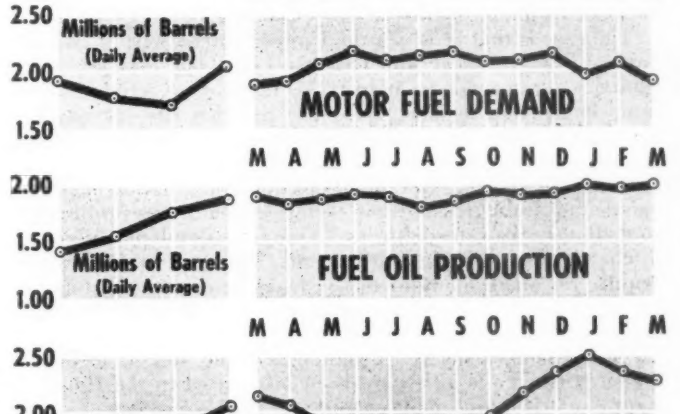


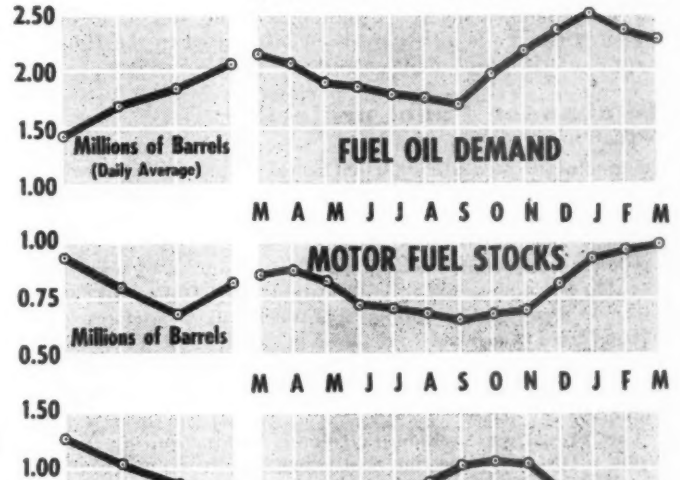


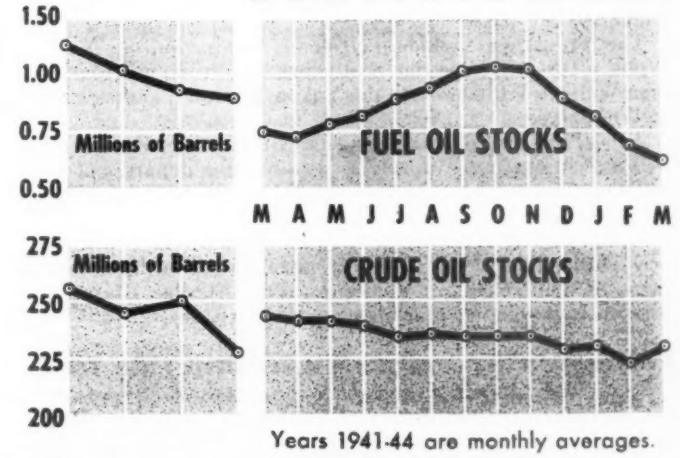
March and February figures are estimates.



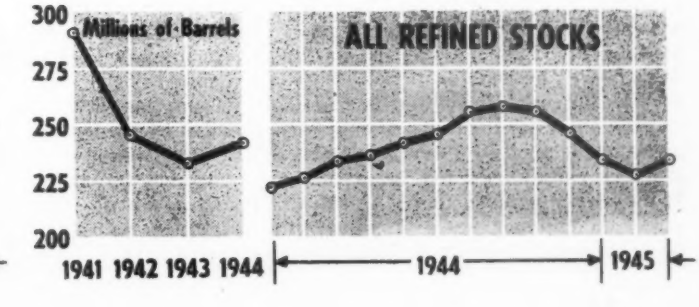



Millions of Barrels
(Daily Average)
MOTOR FUEL DEMAND
M A M J J A S O N D J F M
Millions of Barrels
(Daily Average)
FUEL OIL PRODUCTION
M A M J J A S O N D J F M


Millions of Barrels
(Daily Average)
FUEL OIL DEMAND
M A M J J A S O N D J F M
Millions of Barrels
MOTOR FUEL STOCKS
M A M J J A S O N D J F M



Years 1941-44 are monthly averages.



Highlights IN OILDOM

Intangible drilling cost decision

In a letter to former congressman Wesley Disney, Internal Revenue Commissioner Nunan advises that the Bureau does not intend to follow the decision of the F.H.E. Oil Company case. The letter states:

"The Bureau proposes to continue to follow the provisions of Section 29.23 (M)-16 of Regulations 111, and corresponding provisions of prior regulations notwithstanding decision in case of F.H.E. Oil Company. In the event of a clarification of the law impelling such a change, in no event would such a change be retroactive unless so directed by Congress."

The case is that in which the United States Court of Appeals for the fifth circuit at New Orleans, Louisiana, invalidated the option of the petroleum industry to include intangible drilling costs in figuring income taxes. The decision has stirred up a storm of protest. The general feeling among producers is that the decision would, if upheld, hamper development.

Under the Internal Revenue Department regulation operators can deduct from gross income certain expenditures preliminary to drilling wells referred to as "intangible development costs," or charge them to capital investments. The court decision would require the small operator to pay taxes on each well's total investment instead of on income returnable through depletion over a period of years.

Special congressional legislation is being sought to clarify the situation. Four bills have been introduced in the House of Representatives within recent days with this in view.

To abandon Canol project

The U. S. War Department has announced that operations of the much-criticized $134,000,000 Canol project will end June 30. The decision resulted from the improved military position in the Alaskan area and from the improved tanker situation, it was stated.

Under an agreement Canada holds the option of purchasing Canol at its commercial value and the United States and Canada will now name representatives to appraise the properties.

The Canol project was launched in April, 1942, a few months after Pearl Harbor when Alaska was threatened by the Japanese and the sea route from the United States to Alaska was endangered.

The properties include petroleum production at Norman Wells, a 600-mile pipe line that transports crude oil from Norman Wells to Whitehorse in the Yukon Territory, and a refinery at Whitehorse.

American personnel and movable equipment, such as trucks, will be withdrawn as rapidly as possible, the department said, and several hundred experienced refinery men will be released for jobs in the United States.

Still to be left in operation is a petroleum products pipe line, which will deliver motor fuels from Skagway, on the Alaskan coast, to Whitehorse and thence down the Alaskan Highway to Watson Lake and up the highway to Fairbanks.

California proclaims ownership tide lands

"The State of California has taken a step of such transcendent importance in the matter of California sovereignty that it ranks alongside the Treaty of Guadaloupe Hidalgo and the Act of Admission to the Union," said Rush M. Blodget, executive vice president of Oil Producers Agency of California in a recent statement. "That step was the passage by unanimous vote of both houses of Senator Jess R. Dorsey's Senate Joint Resolution No. 15, in which California abandoned its suppliant attitude of petitioning for the prevention of encroachment by the federal government upon its sovereign lands, and by a legislative coup d'etat, solemnly declared, as a sovereign state, that California is the owner against all the world of all land along its coast under the ebb and flow of its tides out for 3 English miles, and of its submerged lands reclaimed or unreclaimed, and of the beds of all its lakes and navigable streams, together with the water fauna and flora and minerals in said waters, and all the minerals in and under said lands.

"This official manifesto is the first political interpretation of the Treaty of Guadaloupe Hidalgo since its execution in 1848, and, since the Act of Admission in 1850 it is the first definition by political manifesto of what shall constitute sovereign lands of the State of California," said Blodget. "The Government of the United States has never by treaty or reservation, or by political proclamation or documentary manifesto, asserted title to these sovereign lands, and the doctrine of res nullius alone is sufficient to give preponderating weight to the present state manifesto.

"Furthermore," said Blodget, "a political decision of a sovereign state cannot be questioned by its courts, and must be enforced by all its officials and executive officers. Inasmuch as the courts of the state and federal government by an unbroken line of decisions have already conceded the title of the sovereign State of California, the matter may now be deemed to have full political and legal support as far as California is concerned.

"Bills are pending in congress that concur for the federal government in the political manifesto of our legislature, and it is to be hoped that it will not be necessary to protect California's sovereign lands by other than peaceable persuasion."

Production out of balance with drillings

The impact of war upon the oil industry of Texas is indicated by the fact that the state produced 23 per cent more oil during the first 3 years of the war than it did in the 3 years immediately before the war, but it was not able to achieve a corresponding increase in drilling, the Texas Mid-Continent Oil and Gas Association pointed out recently.

"To meet the demands for oil for the war effort, Texas increased its production by drawing on reserves built up before the war," the association said. "Texas produced 1,825,562,000 (billion) bbl. during the first 3 years of war, an increase of 23 per cent over the 1,483,308,000 bbl. produced in the 3-year period before war broke out.

"By contrast, new oil wells brought in since war started total 8940 against 20,573 new wells brought in during 1939 to 1941, inclusive. This is a drop of 56.5 per cent. The 8940 new wells represent 60 per cent of the total of 14,838 holes drilled during the war period, whereas the 3-year prewar record of 20,573 wells represents 73 per cent of the 28,246 holes drilled.

"In response to the government's request to the petroleum industry to make extraordinary efforts to find new reservoirs of oil, 40 per cent of the wartime drilling was exploratory holes compared with 25.7 per cent before the war. Of all the holes drilled since the outbreak of war, 36 per cent were dry contrasted with 24 per cent in the 3 years before the war broke out.

"The drilling cost per well jumped 34 per cent. This increase was occasioned chiefly by higher wages, greater costs for materials, wartime delays, and expenses incurred by complying with government regulations. Today, the cost is up nearly 50 per cent.

"The extraordinary production of 23 per cent more oil to supply war needs, plus the 56 per cent cutback in new oil wells are adverse factors that have thrown the oil industry of Texas out of balance. It will require considerable time and favorable economic conditions to overcome the strain put on the reserves of oil during the period when there was no corresponding expansion of drilling to replace those reserves."

Drilling restrictions extended.

The Petroleum Administration for War has extended indefinitely restrictions on the use of butane and propane-butane mixture for drilling oil and gas wells when gas is available. Continued scarce supplies make the extension necessary, PAW said. It had been planned to lift the restriction on April 1.

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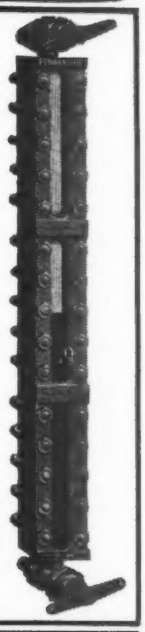

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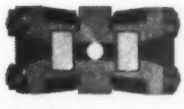
The "Transparent" is one of the complete line of Penberthy gages that meet every liquid level gage requirement.



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MAJOR *Oil Field* ACTIVITIES

● **TEXAS.** The Arkansas-Louisiana Gas No. 1 Baker, L.G.A. Steele survey is awaiting production test. Situated northeast of Elysian Fields and 6 miles southwest of Waskom, the well shows gas both in the Pettit zone of the basal Trinity at 5730 ft., and in the Travis Peak at 6073 ft. It is also said to have some production possibilities in the Hill zone, 5015 ft. Total depth is 6785 ft.

The South Myatt area of Tyler County has been opened with the completion of Atlantic Oil Company No. 1 Houston-American BBB&C survey. The well has a potential of 399.60 bbl. of 54.9-gravity oil daily from 8379-82 ft.

In Goliad County, Sun Oil Company has opened a new pool with No. 1 R. A. Thompson. It flows 140 bbl. of 44.1-gravity crude daily from 11,161-181 ft.

A shallow oil strike for southwest Texas is the Gorman and McDermott No. 2 Welder, halfway between the San Ignacia and North Government Wells pool, Duvall County.

Stanolind Oil and Gas Company, Tide Water Associated Oil Company and Skelly Oil Company have completed No. 1 Hardy and Horn, to open a gas-condensate pool in Matagorda County, upper Texas Gulf Coast. Production is from 10,316-322 ft. Production tests have not been completed.

● **WYOMING.** Continental Oil Company has discovered a new field in the Tensleep sand with its Ida Goodstein No. 1, NE SE SW 20-57n-99w, South Elk Basin, Park County. The well indicated a flow of 148 bbl. per hour on drillstem test from 6971-94 ft. Total depth of the producer is 6995 ft.

● **NEW MEXICO.** Skelly Oil Company No. 2 Steeler, wildcat, 17-23s-37e, six miles southwest of the discovery for lower Permian production shows possible commercial production. Streaks of oil were discovered between 6137-7200 ft. Hole is bottomed at 7200 ft.

Lea County, eastern New Mexico, has a new pool with the opening of Gulf Oil Corporation No. 1 Paddoc, 1-22s-27e, three and a quarter miles north of the company's No. 1 Drinkard. The wildcat shows for possible production in the Glorietta lime of the upper Permian. From 5150-5288 ft., the well flowed at the rate of 16 bbl. of 38.3-gravity oil per hour, with 393,000 cu. ft. of gas daily.

● **CALIFORNIA.** A deeper pay zone has been discovered in the Newhall pool, Los Angeles County, 40 miles northeast of Los Angeles by Barnsdall Oil Company. The No. 44 RSF on the Newhall Land and Development Company ranch flowed at the rate of 750 bbl. of 36-gravity oil a day in the "Six Sand Zone."

● **KANSAS.** The Sunflower State has a pool opener with Continental Oil Company No. 1 Norris, SE SW NE, 9-22-20w, near the town of Burnett, extreme western Pawnee County. The wildcat found saturation in the Kinderhook of the Pennsylvanian. The pay was picked up at 4403-33 ft. Previously the well was drilled to the Arbuckle lime at 4702 ft.

Gulf Oil Company opened a new pool for Ellis County with No. 1 Dreiling, C S½ SE SE 19-13-16w. Brought in from the Arbuckle lime at 3492 ft., the well opened the Herzog pool, which drew a potential of 2463 bbl. of oil daily.

● **ILLINOIS.** Magnolia Petroleum Company has a pool opener with No. 1 Fletcher Stanley, SW SW NE 12-4n-8e, about 5 miles northeast of Sailor Springs and 9 miles northwest of Fairfield. The pay is in the Rosiclaire from 3003-05 ft. with total depth of the hole at 3005 ft.

Aetna Oil, R. S. Hays, William D. Flynn and George and Wrather Drilling Company No. 1 Greathouse, SW NE NW 23-1n-10e, three miles southwest of West Salem in Edwards County, is continuing testing. The pay is in the McClosky limestone from 3247-54 ft. After acid treatment the well pumped 224 bbl. of oil in 24 hr.

H. H. Weinert of Seguin, Texas, has a good producer in the No. 1 Homer Kisner, SW NE SE 31-5-9e, White County, 4 miles southwest of Carmi. Only two of the four prospective pay zones have been tested. They are the Rosiclaire and the McClosky from which the well pumps 12 bbl. of oil an hour. The other two, Lower O'Hara and McClosky, both of which showed signs of commercial productiton on drillstem tests, have not been fully tested yet.

● **ARKANSAS.** Barnsdall and Sohio Petroleum Company No. 1 Moore-McClendon, CNE 34-17s-24w, found saturation and odor at 8188-98 ft. The possible discovery is in the McKamie sector of Lafayette County in the southwest part of the state.

New Devonian pool

Another oil pool for Texas Pacific Land Trust holdings, Ector County, West Texas Permian basin has been opened by Rowan Drilling Company of Fort Worth. The No. 1 TXL, 3 miles southeast of the first deep pool opened by Shell Oil Company, Inc., and Cities Service Oil Company, is the initial producer. Production is from the Devonian lime. Flow is at the rate of 588 bbl. of oil in 6 hr., or approximately 2300 bbl. daily. Production is from an 89-ft. pay section, 7826-7916 ft.

● **OKLAHOMA.** J. E. Crosbie, Inc., and Warren Petroleum Corporation No. 1 Sykora NE NE SW 20-12-7, Okfuskee County, is a possible pool opener in both the Cromwell sand and the Hunton lime. Total depth is 4751 ft. Tests showed 300 ft. of oil in the Cromwell sand between 3892-95 ft. and 90 ft. of oil in the Hunton between 4445-70 ft.

Alfalfa County appears to be getting its first oil pool after a 17-year search with the opening of No. 1-A Young, C NW NW, 14-24-11w. H. M. Acre, independent oil man, and Ace Gutowsky, who opened the West Edmond field, are operators. The well is near McWillie in the southern part of the county. An electric log showed three distinct porosity zones, 5342-48 ft., 5408-50 ft., and 5473-89 ft. Operators will test.

The Carter Oil Company apparently has a good oil producer from the Wilcox sand in its No. 1 McBride, McClain County, west of the Nemaha River. The well flowed at the rate of 35 bbl. of oil an hour without trace of water or mud.

Con-Tex Petroleum Company opened the Fairview field with No. 1 Wolfe, NE SW SW 34-24n-3w, Garfield County. The field has been given an allowable of 300 bbl. daily.

No. 1 Williams, NE NE SW 27-6s-7e, drilled by the Amerada Petroleum Corporation and Gulf Oil Company, is in Bryan County. It opens Southwest Aylesworth pool, which was given an allowable of 150 bbl. per well per day.

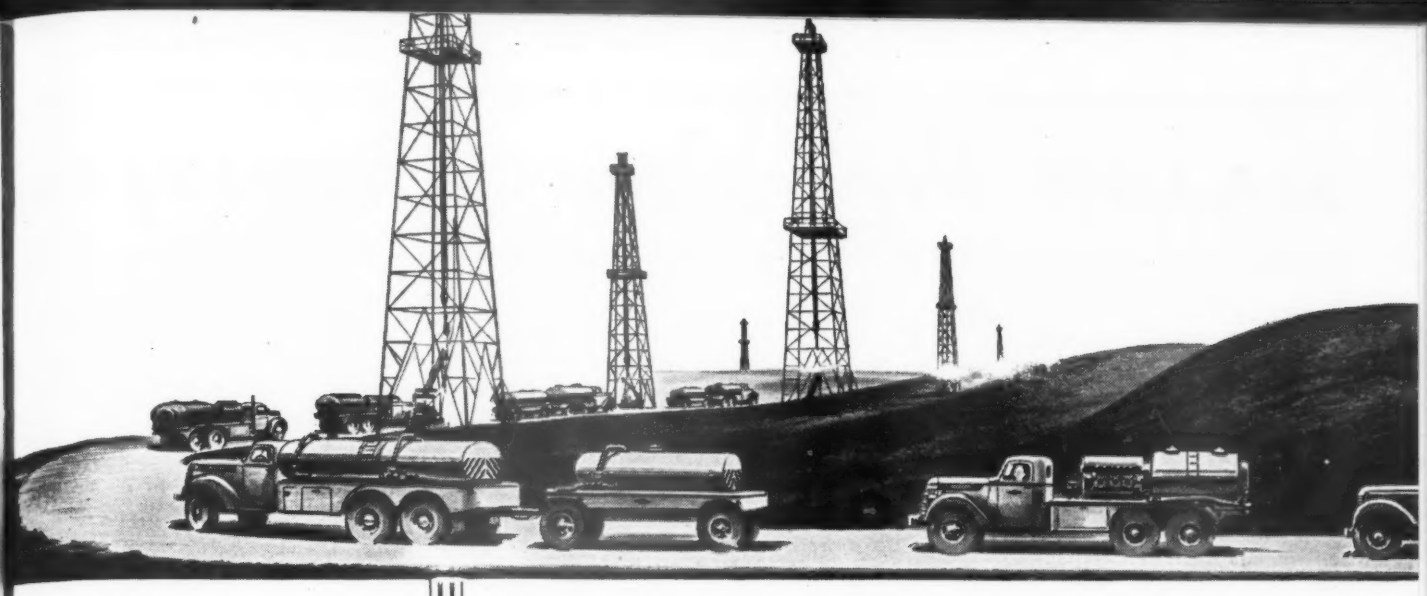
The West Stillwater-Misener of Payne County, a strike of Hanlon-Buchanan, Inc., has been given an allowable of 75 bbl. daily.

● **LOUISIANA.** The California Company, a subsidiary of Standard of California, has given southern Louisiana a new field with the opening of No. 1 Brady in the Miocene formation. On test the well flowed at the rate of 230 bbl. of oil a day from 9897-9904 ft. in the Miocene formation. The wildcat is midway between the Barataria and Delta Farms fields.

In the West Oretta area of Beauregard Parish Magnolia Petroleum Company has completed No. 1 Musser-Davis Lumber Company, 33-6s-11w, to open a new pool. The test flowed 174 bbl. of oil daily. Production is from 8708-12 ft.

Union Sulphur Company has a prospective pool opener with No. 1 Kahn, 25-7s-1w, which on one-hour drillstem test flowed 195 bbl. of 33.1-gravity oil. Production is from 9610-18 ft. The producer is in the South Bayou Mallet area of Acadia Parish.

Barnsdall No. 3 Miller, 31-7s-2w has showed for production in a new sand in the West Tepetate pool of Jeff Davis Parish. On drillstem test in perforations 8400-08 ft., it flowed at the rate of 600 bbl. daily. Tests continue.



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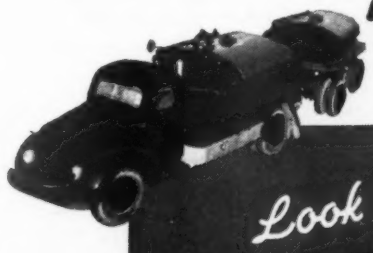
RRECT APPLICATION

PRECISE LOCATION



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MAJOR *Pipe Line* ACTIVITIES

● **DELAY PROJECTS.** Lack of needed equipment and material is delaying work on several pipe line projects, according to PAW. Construction work cannot start on Interstate Oil Pipe Line Company's 120-mile pipe line project from Mississippi oil fields to Baton Rouge, Louisiana, until pipe is received from the mill. The carrier will be of 8-in., 10-in., and 12-in. size. All pipe has been received for Sinclair Refining Company's 36-mile line from Big Sand Draw to Crook's Gap, Wyoming. On the 23-mile line from Crook's Gap to Lost Soldier, all pipe has ben welded. The project of Utah Oil Refining Company for a 60-mile crude carrier from the Rangely pool to Craig, Colorado, will likely be revised.

● **VENEZUELAN OIL.** *Lack of pipe line and storage space is said to be keeping Venezuelan output under 1,000,000 bbl., the mark set for early 1945. February production averaged 747,000 bbl. a day, which is about 80,000 bbl. short of the peak set in September of 1944.*

● **SURVEY TO DETERMINE ROUTE.** Utah Oil Refining Company engineers have started surveying rugged terrain to determine the most suitable route for its 10-in. pipe line to be laid from the Rangely field, Rio Blanco County, Colorado, to the main trunk line across southern Wyoming to its refinery terminus at Salt Lake City, Utah.

● **CONTRACTS FOR TANKERS.** Contracts for the construction of 24 coastal tankers have been awarded to three shipbuilding concerns, the United States Maritime Commission has announced. United Concrete Pipe Company, Long Beach, California, will build 6 of the tankers at a price of $588,929.60 each. New England Shipbuilding Corporation, South Portland, Maine, will build 12 of the tankers at $595,168 each, and the Avondale Marine Ways, Inc., Westwego, Louisiana, will deliver 6 tankers at a price of $662,214 each.

● **GAS LINE AUTHORIZED.** Panhandle Eastern Pipe Line Company has been authorized by FPC to build new facilities to ease a shortage of natural gas for war production in the Appalachian industrial area following an urgent request by WPB for immediate installation of the new facilities. Total cost of the installation is estimated at $8,325,000. Priorities for materials have been granted. A new compressor station in the Hugoton, Kansas, gas field and improvements at other stations in Panhandle's system will be installed.

Improvements will increase the daily capacity in the Appalachian region by 50,000,000 cu. ft. per day, the company said. The present supply runs about 330,000,000 cu. ft. Most of the additional gas, the commission said, will go to the Ohio Fuel Gas Company for distribution in the area that it serves. Midwestern Constructors, Tulsa, Oklahoma, has been awarded contracts for much of the new work authorized. Panhandle's home office is in Kansas City, Missouri.

● **TO EXPAND MOVEMENT.** **Priorities to install 5 new electric-powered pumping units on its system from Midland to Corsicana, Texas, have been granted Magnolia Pipe Line Company. The units are designed to break the transportation bottleneck out of the West Texas Permian Basin for additional supplies of sour crude oil. The new equipment will increase the capacity of the 12-in. carrier by 7000 bbl. daily to a total of 62,000 bbl. Units replaced by the new pumps will be moved to the Midland terminal to aid in the capacity increase there.**

● **EAST TEXAS LINES.** Humble Pipe Line Company will build 9 miles of 8-in. line from the Sand Flat pool of northern Smith County to connect with its Hawkins line. At present the company is trucking the oil. Humble also has increased capacity of its carrier from the Sand Hills pool of Crane County, West Texas Permian basin, with the addition of 3.3 miles of 4-in. loops paralleling its present carrier.

A 3-in. welded line will provide an outlet for the Bacon Lime LaRue field in Henderson County north of Athens. It is being constructed by Merrimac Oil Company from the discovery well, Lone Star No. 1 Lee, to the Ash Switch loading rack on the Cotton Belt railroad, three miles away.

● **RE-LAY LINE.** *Anderson Brothers, contractors of Houston, Texas, are taking up and relaying 4800 ft. of line across the Chariton River, Missouri, for Sinclair Refining Company. The carriers, consisting of 1200 ft. in each of four 8-in. lines, is a part of Sinclair's Mid-Continent-Chicago system.*

● **PLAN NEW CARRIER.** Panhandle Eastern Pipe Line Company has filed application to construct a 16-in. line connecting with its main 22-in. transmission line at its Detroit, Michigan, regulator station and extending to River Rouge, Michigan, and from there to the west bank of the Detroit River. The application also proposes two parallel 12¾-in. lines connecting with the 16-in. carrier at the west bank of the Detroit River in River Rouge. Submitted also was application for a pressure-reducing station and a measuring station to be situated between the existing 22-in. transmission carrier and the proposed 16-in line.

● **PHILLIPS COMPLETES LINE.** Phillips Petroleum Company announces the completion of 7 miles of 6-in. line on the outskirts of Oklahoma City, Oklahoma. The line was laid by Parkhill Truck Company of Tulsa. The latter company also reports nearing completion, 25 miles of 6-in. pick-up, 25 miles of 6-in. relay and 7 miles of 7½-in. pipe for Swinerton and Walberg, pipe line contractors who are laying the line for the Shell Pipe Line Company in the vicinity of Odessa, Texas.

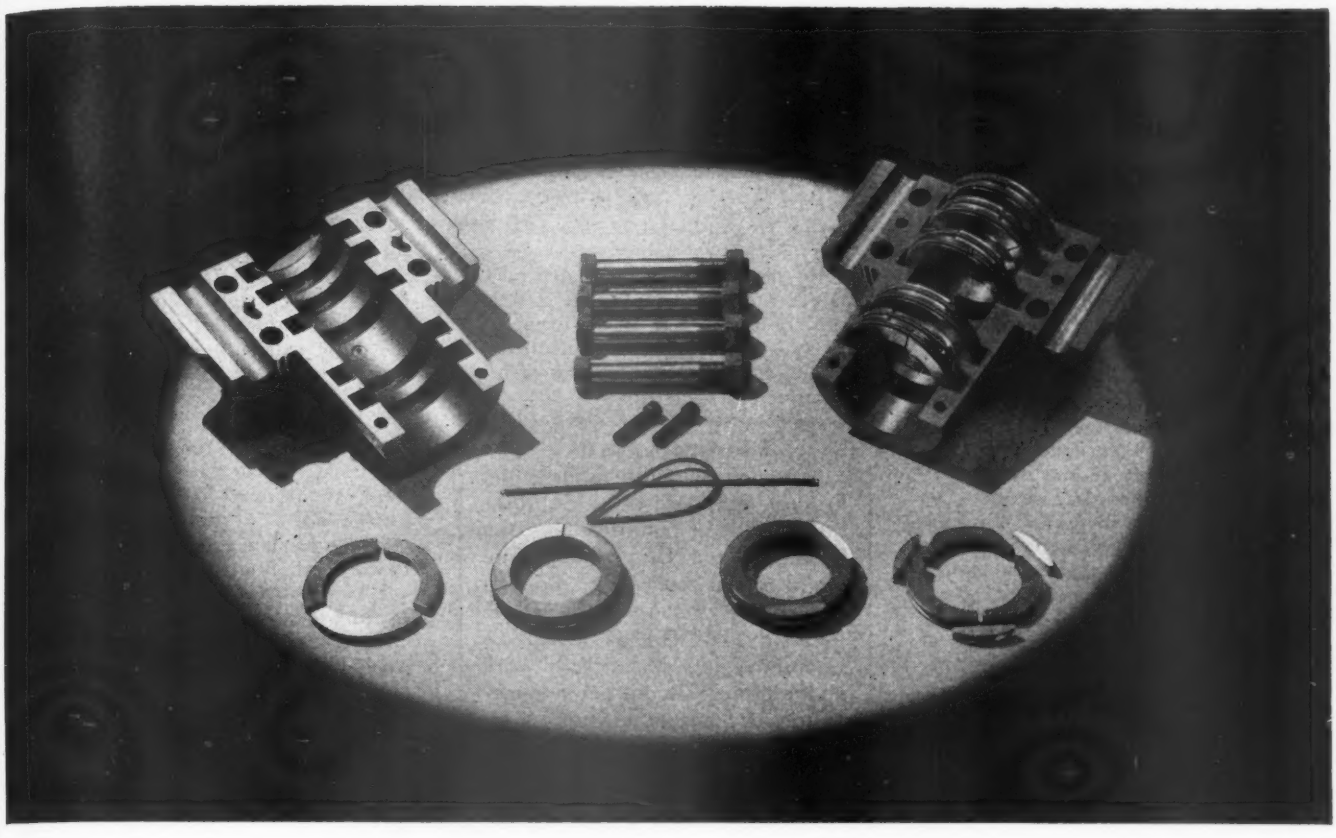
● **TO IMPROVE WATERWAYS.** Approval of plans for improving the Sabine-Neches waterway is being sought by a delegation of Texans. Heavy movement of oil by tankers is given as the main reason for the proposed improvements. Civic and business leaders from Beaumont, Port Arthur, and Orange, Texas, joined by representatives of New York and New Jersey oil and shipping companies comprise the group backing the program as a postwar project.

● **LINE INTO SERVICE.** **Gulf Refining Company has completed and placed in service its 63-mile 8-in. crude line from the Keystone-Ellenburger field to Midland, Texas, according to an announcement released by PAW. Other pipe line projects are progressing according to schedule, PAW said.**

● **TANKERS FOR WAR.** Tankers that have been hauling civilian petroleum products from Gulf Coast refineries to East Coast ports have recently been diverted to military service "to meet urgent overseas requirements of the armed forces," according to Ralph K. Davies, deputy PAW administrator.

● **PROPOSED GAS LINES.** Exports of Texas natural gas to 24 states would be increased to more than a trillion cubic feet annually by proposed new big lines in addition to the ones already in existence, according to a recent survey by Dr. E. P. Schoch, professor of chemical engineering at the University of Texas. Lines proposed are: One from the Permian Basin to Los Angeles, one from the Panhandle to California, one from the Panhandle to the Midwest, one from East Texas as a loop to the Appalachian area, one from East Texas to the Midwest, one from Southwest Texas to the Southwest States, and one from the Rio Grande Valley to Old Mexico.

● **LINE TO ASSURE GAS SUPPLY.** A new pipe line for natural gas in the Panhandle will assure an ample supply of sour gas for new plants manufacturing carbon black, Chairman Otis Culberson of the Texas Railroad Commission has assured WPB. He also told officials that the new line from Rock Creek to the east end of the field where the plants are situated is in the process of completion.



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MAJOR *Refining* ACTIVITIES

● **ADDITIONS FOR STANDARD.** Additional facilities at an estimated cost of $22,000,000 are being installed by Standard Oil Company of Indiana in its Sugar Creek refinery near Kansas City, Missouri. The additions, including a $400,000 laboratory and research unit, will increase the company's output of 100-octane gasoline for aviation use. The new units will be constructed so that they may be quickly and easily converted to the manufacture of automobile gasoline for the postwar period. Preliminary work on the construction job has already started, A. W. Peake, president of the company said, but formal documents from WPB are needed to put the work into full swing. Construction of the facilities is being financed entirely with company funds.

● **ARABIAN REFINERY.** Twelve hundred free Italians have been sent to Saudi Arabia to work on the Arabian-American Oil Company's Ras Tanura refinery, according to PAW. The laborers, transported from Africa will help to complete the refinery ahead of schedule.

● **CO-OP BUYS PLANT.** The National Cooperative Refinery Association has purchased Pryor and Lockhart, Inc., independent oil producing company with offices in Wichita, Kansas. This is the first time the association has purchased a company outright, though it owns an interest in 10 producers. The sale gives the cooperatives a working interest in 46 additional producing wells and transfers lease interest in more than 18,000 acres of drilling sites in Kansas. Pryor will temporarily continue as head of the Wichita office.

● **REFINERY ON STREAM.** The half-million-dollar addition to Sunray Oil Corporation's refinery at Allen, Oklahoma, went on stream this month according to F. L. Martin, president of the firm's refinery operations. Cracking capacity of the plant was enlarged to 5500 bbl. and the total daily crude throughput to 12,000 bbl. with the completion of the new unit. The greater selectivity of cracking made possible by the new installations will result in deeper and more efficient cracking of charging stock, according to Martin. The increased output of refinery gasses recovered from additional throughput and deeper cracking will tax the capacity of the present polymer-codimer unit. Plans have, therefore, been made to install a depropanizer unit to utilize these gases in the manufacture of butane-butene, a feed stock for alkylation plants. The alkylate, a valuable component of 100-octane aviation gasoline, will be shipped to other refineries in Oklahoma operating alkylation units. Equipment installed simultaneously at the Sunray refinery include an enlarged absorber and stabilizer, enlarged electric power plant, a regenerative caustic gasoline treating unit, and a new and larger blow-down system.

Only one other plant, situated on Curacao, Netherlands West Indies, is known to be built with the three-furnace design. It is engineered by Universal Oil Products Company and has proved highly satisfactory.

Toluene plant

A toluene manufacturing plant to cost approximately $6,600,000 has been authorized by the Defense Plant Corporation. The plant to be built near Borger, Texas, will be operated under lease by the Phillips Petroleum Company. DPC officials said work on the project should begin immediately. A contract has been signed with the Bechtel-McCone Company to build it. The toluene was ordered by Army ordnance as an ingredient for high explosives.

● **MILLIONTH BARREL.** Associated Refineries, Inc., Duncan, Oklahoma, announces that it has recently completed manufacture of its millionth barrel of 100-octane aviation gasoline. In most respects different from any other 100-octane plant, Associated was built from the ground up, not forming part of any other refinery. It draws its raw material from 8 independent refining companies: Anderson-Prichard Oil Corporation, Bell Oil and Gas Company, Ben Franklin Refining Company, Fen-Ter Refining Company, LaSalle Petroleum Corporation. Panhandle Refining Company, Rock Island Refining Company, and W. T. Waggoner Estate.

● **SYNTHETIC RUBBER.** Production of special synthetic rubber latex now exceeds one and a half million pounds per month at one of the government's latex producing plants, operated for Rubber Reserve Company by United States Rubber Company at Naugatuck, Connecticut, according to J. P. Coe, general manager of the company's synthetic rubber division. This liquid form of synthetic rubber replaces natural rubber latex where it was used in the manufacture of most synthetic rubber tires, and in fabric and paper impregnation.

Nearly ten million pounds of the synthetic rubber were produced last year at the Naugatuck plant and production by the end of 1945 is expected to reach two million pounds per month.

● **MEXICAN OIL.** The Mexican oil industry will be able to process 42,000,000 bbl. of oil this year and to export about 6,500,000 bbl. The additional refining activities are a result of better conditions within the industry, the government says.

● **CARBON BLACK PLANTS.** Plans for construction of a $1,048,000 carbon black plant at McCoy, 2 miles north of Rodessa in Caddo Parish, Louisiana, are virtually completed. Under present plans the plant will be financed by DPC as a war project and will be operated during the war by Cabot Carbon Company.

Additional constructions on the Cabot Carbon Company refinery at Guymon, Oklahoma, have been approved. The total expenditures for expansion will be $1,019,278.

Union Carbon Company's new carbon black plant situated near Odessa, Texas, will be in partial operation by May 1 according to Oscar Nelson, company president. The plant, largest of its kind in the world, is expected to reach full capacity of 41,000,000 lb. by July 1.

A partial list of carbon black projects not listed above that have been given AA-1 priority are: Cabot Carbon Company at Wickett, Texas; Cities Service Oil Company in Ector County, and in North Cowden, Texas; Columbian Carbon Company at Seagraves, Texas; J. M. Huber, Inc., Borger, Texas; Jefferson Lake Sulphur Company, Clements, Texas; Charles Eneu Johnson, Eunice, and Monument, New Mexico; Phillips Petroleum Company, Borger and Goldsmith, Texas, and Eunice, New Mexico; Roxboro Steel Company, Hardin, Texas; United Carbon Company, Ryus, Kansas, Ector County, Foster Field, and Midland, Texas; United Carbon Judkins Company, Ector County, Texas. The new plants and new facilities in old plants will add 188,100,000 lb. of carbon black yearly to present production capacity.

● **OIL BOMB.** The M-69 oil incendiary bomb, developed with the army's chemical warfare service by Standard Oil Company of New Jersey, contains jellied gasoline that is scattered forcibly in gobs of sticky flaming material against the sides of buildings. It can be dropped in clusters. It looks like a piece of hexagonal pipe, is cut off square at the ends and has no fins, but receives its stability from cloth streamers that come out when the bomb falls free. The clusters of bombs break open and scatter as they fall earthward.

● **COMPLETE REFINERY.** Sunset Oil Company completed construction of its new refinery in Torrance, California, recently and began operating April 1. The men in charge of operations are Earl Griener, refinery superintendent; M. V. Moulton, chief engineer of plant and pipe line; O. J. Clark, chief chemist; and J. P. Vezetti, vice president and general manager. Thomas F. Fouinier is new president of the company, and offices are situated in the Lane-Morgage Building, 208 West 8th Street, Los Angeles.

THE Petroleum Engineer

APRIL, 1945

MODERN COMPRESSOR STATION DESIGN

By **HAROLD F. DAWE,** *Gas Engineer*
The Stearns-Roger Manufacturing Company

EXCLUSIVE PIPE lines handling natural gas to the eastern states from middle western or Gulf states have been doing yeoman service in supplying gas that is greatly needed. Increasing demands on all gas pipe lines make it imperative that the installations function with a minimum of shutdown time and at maximum efficiency. This pertains to the entire installation, including piping.

Our thinking in regard to compressor station design has undergone changes during the last few years that will ultimately result in vastly improved compressor installations. This is evident in compressor stations that have been recently constructed.

For convenience in the following discussion a typical modern compressor station flow diagram is shown in Fig. 1. This diagram shows the flow of gas through the station, the flow of the cooling water through the various circuits, and the flow of water over the cooling tower and atmospheric cooling sections.

A variation of the flow diagram is shown in Fig. 2. In this flow diagram, the cooling of gas and cooling water is by means of shell and tube exchangers.

● **Compressors.** During the war years the War Production Board has insisted on the use of vertical angle-type high-speed gas-engine-driven compressors. This has been due to the lower weight per horsepower. Growing satisfaction with the performance of these machines, combined with their flexibility, indicate a continued widespread use after the war.

An accumulation of operating experience and data will be shortly analyzed with a view to determining exact cost data. Present information indicates that the cost of operation is little if any more than the slow speed machines. Continuing experience with both machines will yield data on which reliable comparisons may be made.

The high-speed unit has introduced new problems in vibration that were not so prominent in slower speed machines. The high-speed unit has caused more attention to be paid to problems of cooling and lubrication to the benefit of both types of machines.

Installations that will operate with minimum shutdown time and maximum efficiency needed to meet increasing demands for gas.

Continued study of the characteristics of the high-speed machine is resulting rapidly in a satisfactory unit from all standpoints.

Centrifugal compressors will undoubtedly take their place in the field of gas handling, particularly at lower pressures. Centrifugal compression is efficiently possible only up to a certain point, and these compressors have their greatest application below 500 lb. discharge pressure. It is not yet possible to build into a centrifugal compressor with any degree of efficiency the extreme compression ranges that are found in reciprocating machines. Their greatest application will be in lower pressure ranges or where the compression range is short. Pipe lines are most economically installed where the compression range can be built into single cylinders and at present this is possible to do efficiently only in reciprocating machines.

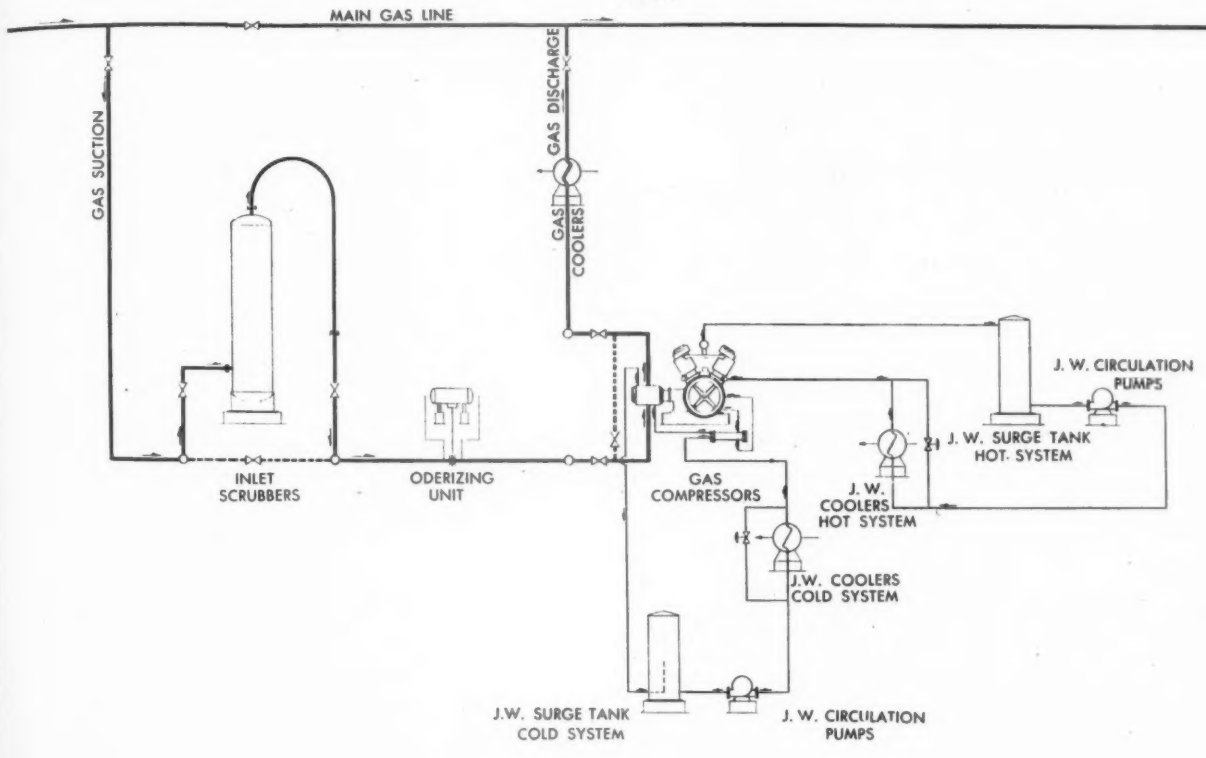
In choosing a compressor installation the greatest flexibility, of course, would come from a selection of small duplicate units. This permits less penalty in terms of gas transported when a unit comes down for repairs, and provides the smallest initial investment in spare horsepower. It does increase the investment in installation due to the increased concrete cost because of smaller pours, more form work, etc. The building size must be increased for equivalent horsepower when using a number of small units and the cost of piping becomes greater. Spare parts costs are about equal but more spare parts must be warehoused when the smaller units are used. An individual economic study must be made to determine such a choice, especially when a line having a high load factor is involved.

It is cheaper, for instance, to provide eight 1000-hp. units than it is to install ten 800-hp. units, but the penalty of a shutdown of one unit is less with the smaller units. Smaller positive or negative increments of horsepower may be used to handle varying loads with smaller units, and cost of operation is also decreased. Less capital investment is made in spare horsepower in the smaller units but operation of equivalent small units costs more than a few larger units, from a standpoint of personnel and maintenance.

● **Piping.** Piping should be designed according to Section 3, Division 2, of

COMPRESSOR STATION FLOW DIAGRAM
24 IN. MAIN GAS LINE
24 IN. GAS SUCTION
INLET SCRUBBERS
GAS COMPRESSORS
GENERATORS
INDUCED DRAFT COOLING TOWER
24 IN. GAS DISCHARGE
J. W. SURGE TANK HOT SYSTEM
J. W. CIRC PUMPS
J. W. SURGE TANK COLD SYSTEM
J. W. CIRC. PUMPS
AIR COMPRESSORS
AIR RECEIVERS

FIG. 2



COMPRESSOR STATION FLOW DIAGRAM

the Code for Pressure Piping by the American Standard Association under the design ASA-B 31.1-1942. This design makes use of the standard set-up for the oil and gas piping inside refinery limits.

The present standard for the design of compressor station piping is inadequate for safe application to piping inside such plants. This section now permits carrying the cross country piping standards into the compressor station, provided such stations are outside cities or villages or closely populated areas. Extensive use of Section 3 of the code covering oil and gas piping inside refinery limits during the last few years, in the design of compressor installations for high pressures ranging from 2500 to 4000 lb., has indicated that heavier wall thicknesses called for by this section are necessary in order to withstand additional stresses imposed by vibration in piping immediately surrounding the compressors themselves.

A recent survey of natural gas line operators indicates their dissatisfaction with the present code and they have deviated from it in designing compressor stations in the interests of greater safety. A recent large installation has been made wherein all piping within the compressor station from the station inlet gas valve to the station side of the outlet valve was in accordance with Section 3, section for oil and gas piping within refinery limits. A compromise standard roughly halfway between the thicknesses called for under Sections 2 and 3 was selected for piping beyond these points and for a distance of some 150 yards each side of the compressor station, also in the main line near the station. This additional safety factor is justified when the concentration of personnel and equipment within the compressor station is considered.

Piping vibration has been probably the most troublesome problem to the designing engineer. In some cases exceptionally rigid and heavy wall pipe has been used. This generally reduces the amplitude of the vibration and may at times result in shorter life for the less flexible sections. Another attack has been to place massive anchors and clamps onto the line at the point of the worst vibration. Much thought has been given to engineering the solution. A recent paper gives good information on this most troublesome problem.[1] Several concerns are now devoting thought to the problem of conquering pulsation vibration through the use of devices that resemble exhaust silencers, in such a manner to break up the large and more evident pulsations into pulsations resembling a continuous flow, with consequent reduction in the intensity of the vibration. These devices make use of the principle of capacity and resistance in such combinations as to give optimum results. This approach will lead to the eventual solution of the problem.

It has been found that vibration otherwise not too noticeable will sometimes appear in destructive form in locations where piping is flexible to take care of expansion, where piping is inadequately supported, or where pronounced directional change takes place.

[1] "Vibration in Compressor Plant Piping," M. L. Arnold, California Natural Gasoline Association, December, 1944.

Several designs of compressor discharge and suction piping have been shown. Fig. 3 shows a discharge piping design into a main station header that has given trouble from vibration. This loop acts much like a bourdon tube in a pressure gage fluxing with each cylinder discharge. A check of this has shown the vibrating frequency to be equal to the discharges per cylinder, the number of cylinders, and the revolutions per engine. Best phenomena is evident when several compressors are discharging into the same header, although the frequency remains the same. Fig. 4 shows a deviation from this design, one that incorporates a shock absorber or snubber. This, of course, is an approach to acoustical vibration dampening and has given a less troublesome loop installation, which also allows a neat supporting pad at the loop entrance. Fig. 5 shows the discharge and suction leads directly into the main headers. In this, the gas has a direct straight flow and there is no flexible portion of the piping to give trouble. The suction header must be placed so that the lead to the compressor can be installed with minimum pipe and bends (Fig. 6) although little trouble has been experienced from suction leads to compressors. Expansion is here a problem and it must be met by allowing the main header to move. Where exceptional compression ratios are encountered temperature expansion of the leads to the header make perfect alignment impossible as an engine may be on or off the line. Vibration from this system is less than from Fig. 3 or 4.

Fig. 7 shows an installation where the loop has been placed in a horizontal

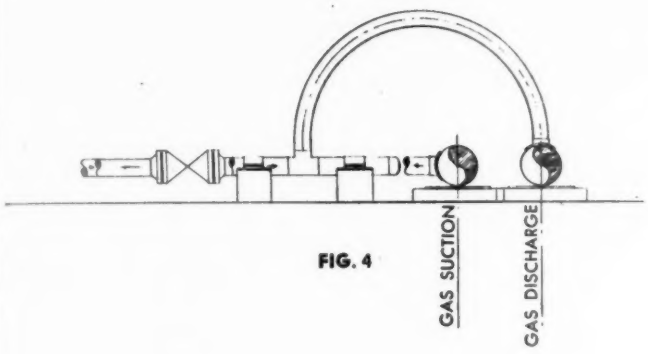


FIG. 4

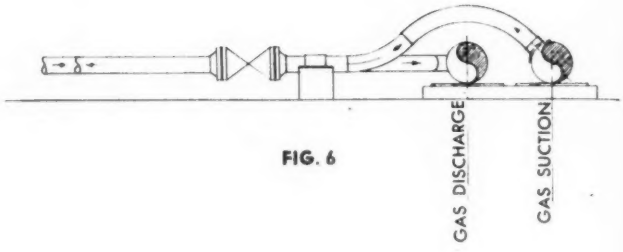


FIG. 6

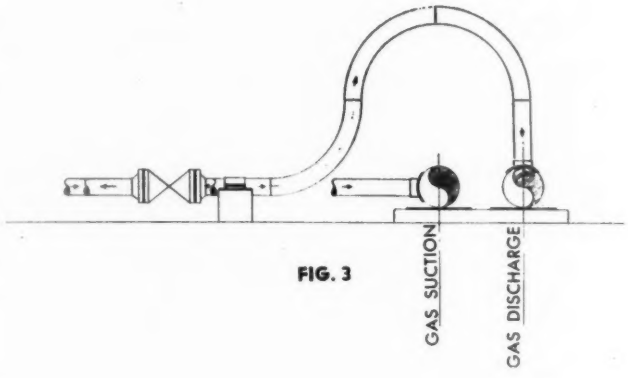


FIG. 3

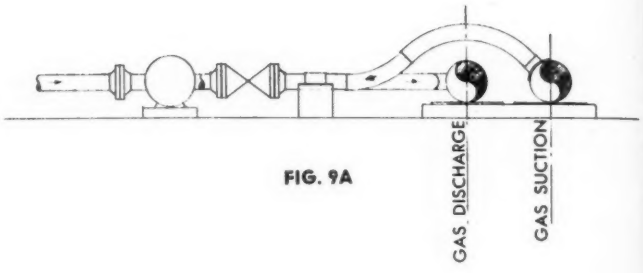


FIG. 9A

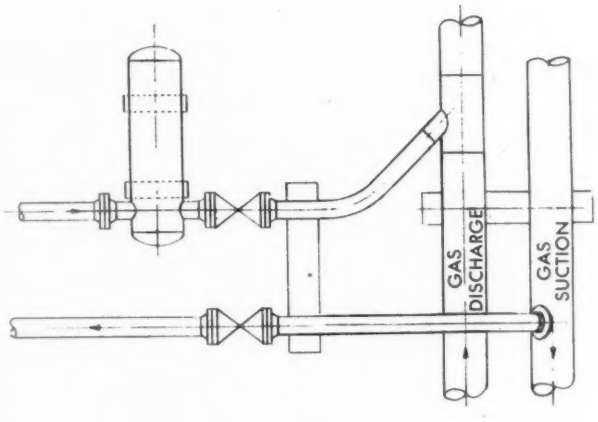


FIG. 9

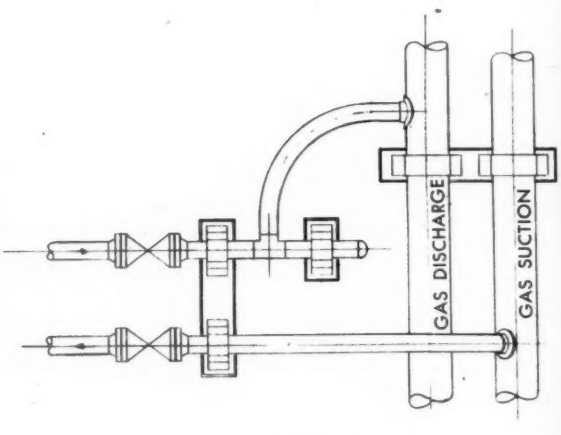


FIG. 7

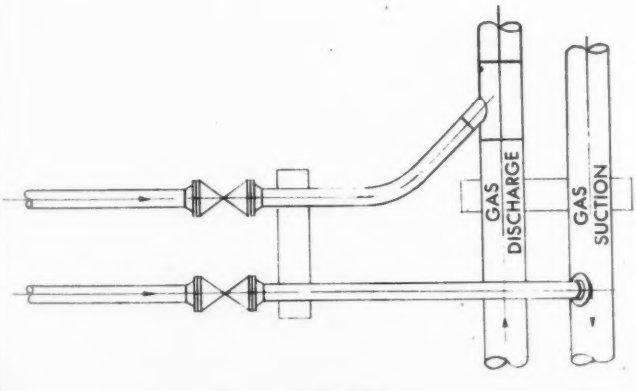


FIG. 8

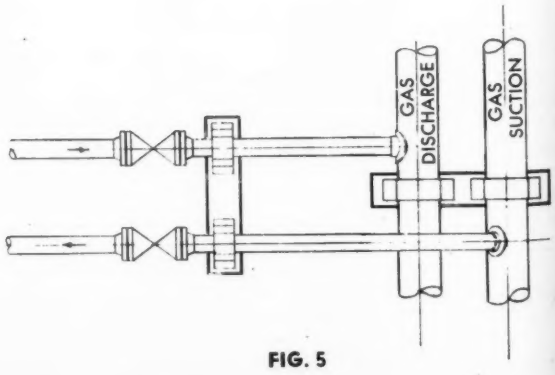


FIG. 5

plane with "snubber." This allows for temperature expansion and provides some measure of pulsation dampening.

Fig. 8 shows an approach to the problem, which provides the necessary flexibility and desirable flow characteristics. It is evident from inspection that a bend in the plane shown can be adequately supported and braced, and yet will be flexible enough to provide for much temperature expansion. The reaction from discharges will be materially reduced, and the piping can be adequately braced. An improvement on this is shown in Fig. 9 and 9A where a pulsation dampener has been installed in the discharge lead. Vibration in such a system should be a minimum when adequately engineered.

Lubricated plug valves are usually placed in the gas piping around the station. This type of valve has proved to be most satisfactory as it provides the positive control of gas flow at all times with adequate operating ease and low maintenance. Some pressure drop is sacrificed due to the restricted plug opening, though this loss is small.

● **Water system.** In the installation of any water cooled compressor and engine the problem of water quality in sufficient quantity for cooling is paramount. In the station itself the problem expands into providing water for generator engines, cooling tower, domestic purposes, and for sanitary facilities.

Usually the most satisfactory water from the standpoint of uniform quality is found in underground reservoirs and tapped by water wells. Where there are known water sands the quality of water from each should be examined and the best water possible should be used, otherwise test borings should be made to determine exact water conditions.

The quality of water available from surface sources varies during the seasons of the year and close check must be kept on the analysis to insure satisfactory water. If possible, surface sources should be avoided, or water should be obtained from a large reservoir where changes in quality of water are not so pronounced. Fig. 10 and 10A illustrate how turbidity and hardness may vary during the year.

Provision should be made for handling turbidity in the surface water to avoid settling out material in the engine jackets, cooling tower basin, and domestic equipment. Reliable commercial concerns can provide excellent advice on handling such water satisfactorily using precipitators, filters, and settling basins. Insurance on engines is less expensive when adequate provision is made to remove the material that may settle out in the engine jackets.

Consideration should be given to chlorination of water when it cannot be directly used for domestic purposes due to contamination. It may also be necessary to soften the domestic water, especially when used as a domestic supply for the station and camp personnel.

Where the water supply is especially bad, provision is sometimes made for distilling water sufficiently for makeup

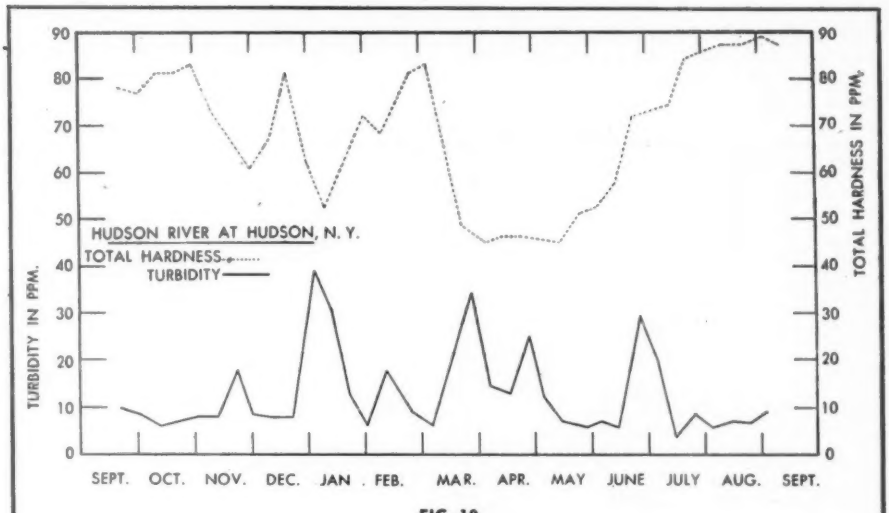


FIG. 10

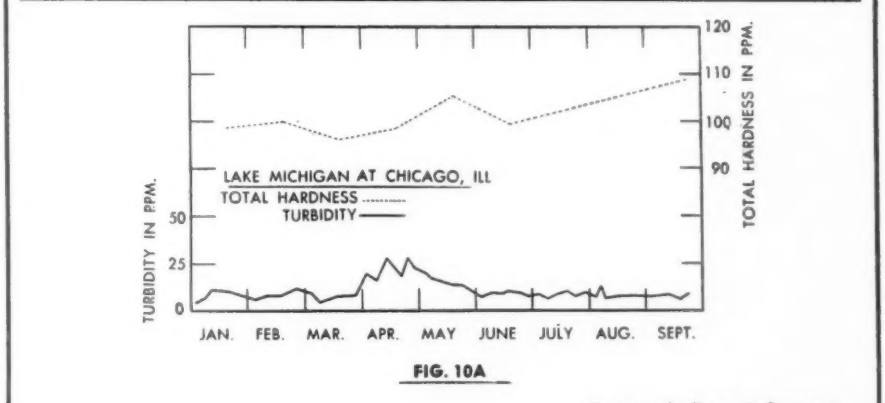


FIG. 10A

Courtesy the Permutit Company

to the closed systems, the closed system here incorporating cold and hot jacket water. The use of distilled water should be resorted to only when it is impossible to obtain satisfactory water from other sources. This water must be inhibited to prevent corrosion and continuously checked for other harmful characteristics.

Much mention has been made of adequate quality water. Increasing attention has been paid to water treatment by chemical means. Many compressor stations are now served by familiar zeolite systems that supply makeup water of low hardness. This is only a partial solution to the problem and recently the most progressive operators have more fully considered their water problems with the idea of providing the best possible water for cooling purposes. With the inhibition of corrosion and low scale forming tendencies much better cooling has resulted. High heat transfer rates have been maintained and more uniform transfer rate conditions have been experienced. In cooling towers, particularly where the water cools through atmospheric cooling sections or through shell and tube exchangers, it is necessary to avoid fouling the tubes with scale and algae. When fouling is prevented, high transfer rates are maintained, resulting in lower cooling costs. The capacity of gas pipe lines is greatly increased through use of colder gas maintained by good cooling.

Generally, the quantity of makeup water to a cooling tower prohibits too expensive treatment and an investigation must be made to determine the per diem costs of treatment that will give satisfactory results. Some sacrifice in cooling efficiency may have to be made when the costs are known; however, it is possible to treat adequately at low cost. In a recent installation where makeup water is added to the tower at the rate of 150 gal. per min. it is costing about $6.00 a day to treat this water satisfactorily. This is approximately $2190 a year for treating 78,700,000 gal. of water, or a cost of approximately $0.000028 a gal. There has been no scale formation and no algae growth.

Water treatment is of minor significance in terms of cost in closed systems, for the makeup to such systems is very small.

● **Cooling water system.** Generally manufacturers of the high speed engines agree that the machines should be run at between 120°F. and 150°F. inlet cooling water temperature. This allows for some choice in inlet water temperature, but all manufacturers agree that a small difference between inlet and outlet water is necessary, 10°F. being ideal. Various systems may be used to achieve this result but not all require the same amount of electrical power. It is important to maintain the power consumption at a minimum in all installations as the water system requires a large portion of the

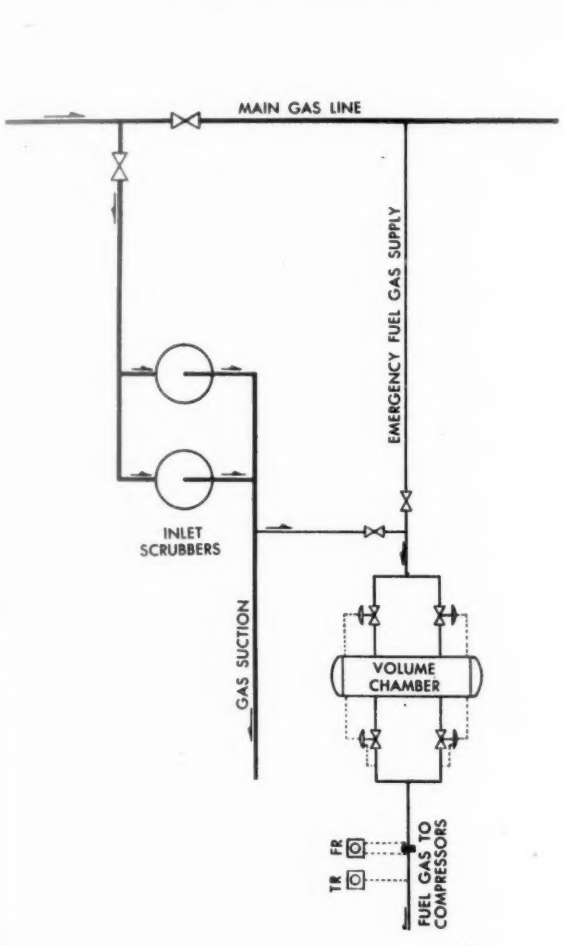


FIG. 11

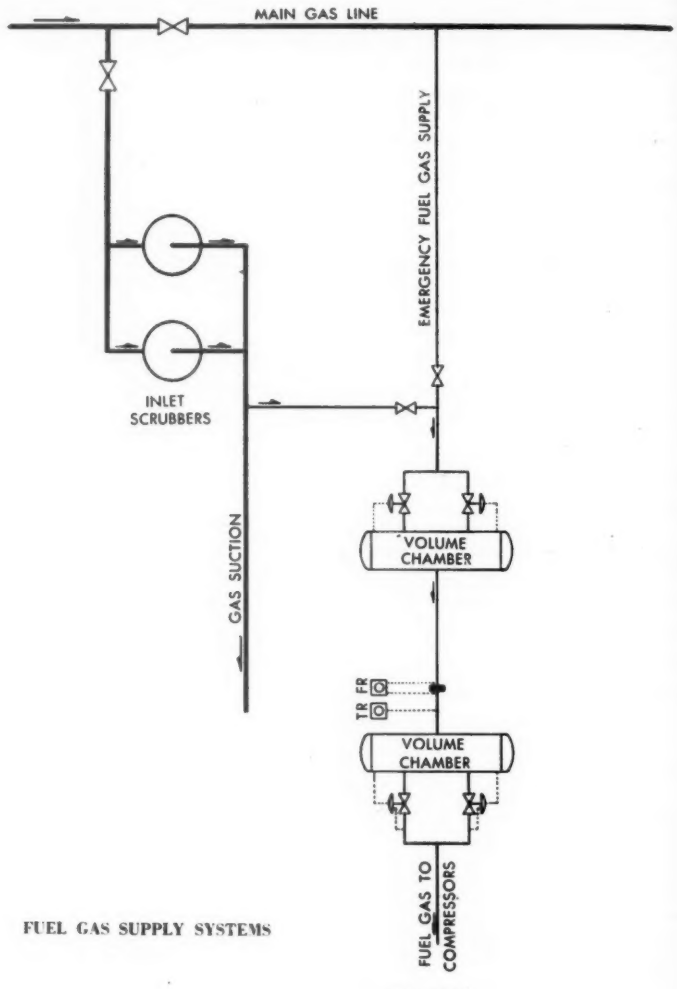


FIG. 11A

FUEL GAS SUPPLY SYSTEMS

generated or purchased electrical energy.

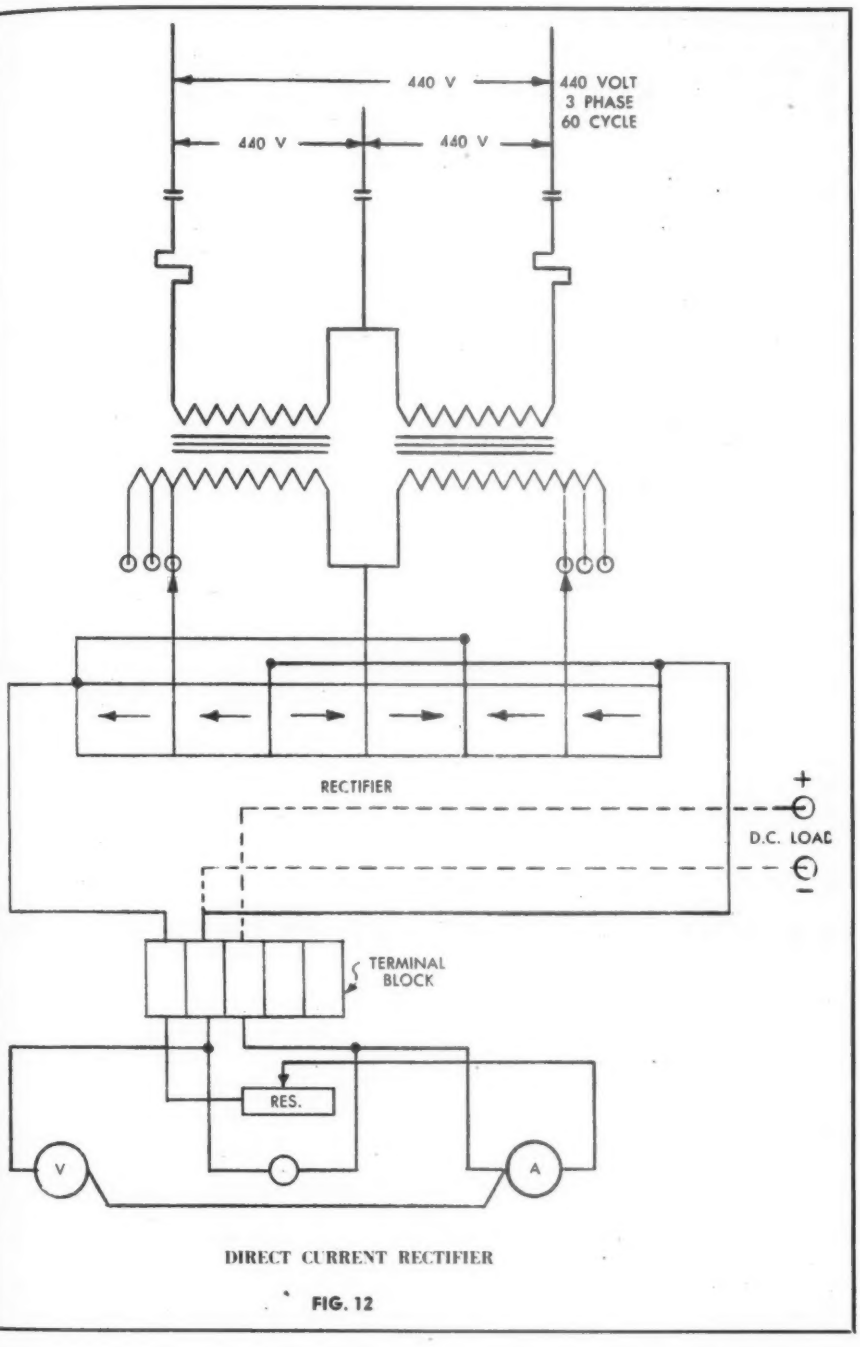
A simple system may be selected that cools all equipment such as compressor engine jackets, generator engine jackets, compressor cylinders, and oil coolers, all cooled by cooling tower coils or by circulation over a cooling tower. It will be found that such a system requires an excessive circulation of water and consequently power costs are high. Also water temperature and quality control are difficult. An alternate system has been used quite successfully to circulate the cooling water through compressor engine power cylinder jackets and generator engine jackets, while a separate circulation of water is maintained through the compressor oil coolers, compressor jackets, and generator oil coolers. These systems tie together after circulation through their respective circuits into one system cooled by coils in a cooling tower. This system is less difficult to control from a standpoint of temperature but still presents the problem of water quality and excessive power costs.

A system has been developed that answers the requirements of low power costs, close temperature control, and water quality control, and which may be modified to meet requirements of warm and cold climates. Two separate systems are used. One, the hot system, circulates water through compressor cylinder jackets and generator jackets in parallel. The proper volume of cooling water is carried at 140°F. and has a maximum rise of 10°F. Fig. 1 shows diagrammatically the flow in such a system using atmospheric sections. Fig. 2 shows a similar system making use of shell and tube exchangers. This type of hot system may have the temperature controlled by installing an automatic control to bypass the cooling coils. The temperature rise is small and the quantity of water circulated and in makeup is at a minimum so water quality is easily controlled. The second, or cold system, circulates water through the compressor and generator oil coolers in parallel and finally through the compressor cylinder jackets, the excess water flow being bypassed. This volume of water is such that the temperature may be controlled by use of an automatically controlled bypass valve, and the closed system allows for close quality control with little makeup water. This system operates at a temperature of about 110°F. inlet and about 120°F. outlet.

The use of the two separate systems allows segregation of cooling coils in the cooling tower and better distribution of cooling water. The heat load of the cooling tower is reduced and the horsepower requirements for circulating the water over the cooling tower are reduced.

A recently completed installation of the above type for 9000 hp. contains about 45,000 gal. of water in the hot system and 15,000 gal. of water in the cold system. The hot system operates at 140°F. and maintains less than 10° rise with a circulation rate of 7200 gal. per min. through 9 engines. The cold system operates at 110°F. and maintains about 10° rise with 1335 gal. per min. circulation.

● **Dust scrubbers.** The installations of a pipe line with compressors is never approached today without considering dust and dirt removal. This is done in various ways, usually by flowing the gas through a volume chamber where some liquid agent is intimately mixed with the gas in such a manner as to moisten dust particles held in the gas stream. On leaving the chamber the gas passes through a scrubbing arrangement whereby the liquid is removed together with the dust it has moistened. In some cases water has been used as a scrubbing medium. This obviously is not possible with dehydrated gas and in such cases an oil is used. Discarded lube oil and oil of all grades has been used with varying success. The oil must have some lubricating property as a carryover into the



DIRECT CURRENT RECTIFIER

FIG. 12

suction would damage engine, rods, valves, and pistons. A very light, inexpensive oil of about 34 deg. API gravity has been found to be successful and has resulted in a carryover during correct operation of a well designed unit of less than 0.1 gallon per million cubic feet of gas. Such scrubbers can be designed to handle any capacity of gas per day and with gratifying results. It is necessary to provide adequate facilities for storing the scrubbing oil and for settling the dirt that has been trapped by the oil. Settling is usually done in small vented horizontal tanks equipped with means for removal of oil and dirt. A convenient way to handle this is to provide these settling tanks with a cone bottom that can empty the dirt accumulation directly into trucks or barrels, and the oil can be removed by swing line. This storage must be completely weatherproof to protect a dehydrated gas.

Provision should be made for storing the fresh scrubber oil in a small 4000 or 5000 gal. horizontal tank. This provides sufficient supply to last for some months and in such size as to be conveniently filled by motor transport truck. Adequate level gages should be installed for quick check on storage volume. A small oil transfer pump is installed to move the oil as required.

The simplest means of filling the scrubber with oil is to make use of a balanced pressure system. In such cases, a pressure vessel is filled with scrubbing oil and placed under the pressure of the system. Gravity then moves the oil into the scrubber. The vessel should be protected adequately from over pressure with pressure relieving devices, and it should also have liquid level gage glasses for checking the oil levels in the vessel.

A future innovation in scrubbers will be the use of electronic dust precipitators. These are in the process of development and will be available after the present war. Such devices will greatly simplify dust removal and dust removal will be more thorough.

● **Lubricating oil.** Lubricating oil ranks in primary importance along with cooling water. Many engine troubles can be traced directly to the use of improper or inferior lubricating oil. A good grade of lubricating oil should be installed in each engine and there should be sufficient bulk storage within the station to handle all requirements for a 60 to 90 day period. The exact specifications for oil for each machine is recommended by the manufacturers and result from long experience. "Trick" additions to lubricating oil on the basis that the quality is improved by such additions should be avoided. Reputable lubricating oil suppliers have incorporated the most modern scientific improvements into their product and improvement of the quality by the layman is doubtful.

It is possible to maintain continuously the quality of the original oil in gas engine drives up to a high standard by the use of oil reclaimers or high grade filters. These units usually heat and filter the oil while hot through a bed of some adsorption material, such as Fuller's earth. Such materials act to sweeten the oil, remove harmful dirt and carbon, and unsaturated material formed in the engine oil. In some reclaimers the light vapors from the dirty oil are condensed and trapped as the oil is treated. In gas engines there is little dilution, in diesels there may be considerable. There is also little water formation in gas engine drives, particularly when in continuous service, and this eliminates the need for centrifuges.

It is possible to trap and salvage lubricating oil from compressor rods, packing gland housings, and other sources and to reclaim this oil for future use, thus effecting considerable saving.

In a recent installation, nine compressor engines are served by two large oil reclaimers and three generator engines by one. These units are so arranged that the oil from any engine may be treated and returned to that engine. Each engine is placed on "reclaim" for a period of about 6 hours. The quality of the oil to the unit can be visually checked by means of a large site glass. A large two-compartment tank housed in the compressor building basement serves to collect dirty oil and also holds the cleaned or reclaimed oil. Laboratory checks indicate the reclaimed oil to have substantially new oil specifications after months of continuous service.

● **Fuel gas supply.** The supply of fuel gas to compressor engines must be carefully maintained within relatively close limits. In accomplishing this result, the mechanism for achieving it should be as simple, effective, and trouble free as possible. A sensitive pressure reducing valve that will maintain the pressure range desired within plus or minus 1 per cent is satisfactory for final regulation on fuel gas installations. Recent-

ly the trend has been to supply gas in a fuel header to all engines and avoid the use of individual engine regulators. This has proved to be entirely satisfactory provided the pipe header is of ample size. A pressure drop of not more than 3 to 5 in. of water for the length of the header is good design. This may be reinforced by providing additional fuel gas volume chambers at each individual engine.

Fig. 11 and Fig. 11A show two fuel gas metering installation diagrams. The primary or upstream fuel gas regulator is sensitive to plus or minus 5 to 7 per cent, and the downstream regulator to plus or minus 1 per cent, and an adequate volume chamber must be provided otherwise the regulators will "hunt." This is especially harmful where station fuel gas metering is performed between regulators, and if this must be done when the fuel gas pressure required is very low, the metering run will be of excessive size.

● **Compressor ignition.** Engine ignition has been by means of magnetos or the direct current impulse type. The supply of ignition to the latter usually has been by means of storage batteries. These batteries were sometimes charged by means of trickle chargers, direct current generators, or rectifiers. Only very recently have the conventional magneto or battery source of power been replaced by individual direct current rectifiers of the copper oxide type. These units are supplied from a 440-volt 3-phase 60-cycle source having their own built-in transformers and provide a steady, virtually rippleless direct current that will supply the ignition demands of all engines. This source of ignition supply power has been thoroughly tested in actual service in one of the largest gas pipe lines in the country. It provides an exceptionally clean and trouble free source of direct current.

In operation this system provides a foolproof interlock between the station electric generators, water circulating pumps, and engines. If electric power fails for any reason, the water circulating pumps or the jacket water system shut down. As the compressor ignition system also shuts down on power failure the compressors are stopped at once, making it impossible for them to overheat by running after failure of jacket water circulation. Another advantage is that each machine has its own individual rectifier unit and is thus independent of all other machines. Thus, the entire station cannot be shutdown by failure of an element of the ignition supply, which is always a possibility when a central battery and charger system is used. The system is also cheaper to install and much cheaper to maintain than either the individual magnetos or a central battery and charger.

A wiring diagram for such an apparatus is shown in Fig. 12.

● **Expansion.** In the installation of any compressor station or other plant adequate provision should be made for future expansion. Lack of consideration of this single item has resulted in many poor ultimate compressor installations that now continuously cause operation and maintenance expense beyond that normally expected. This can be avoided to a large extent by a thorough analysis into possible future operations and by providing against all conceivable possibilities consistent with the appropriation money granted.

When analysis shows budgeted original costs are too low for future satisfaction the appropriation should be increased to take care of this.

Provision should be made for adding future compressors, future generating units, future pumps, scrubbers, cooling equipment (tower and cooling coils), and employe cottages. It is not always possible to cover all possibilities but many can be included in planning for the future. ★★★

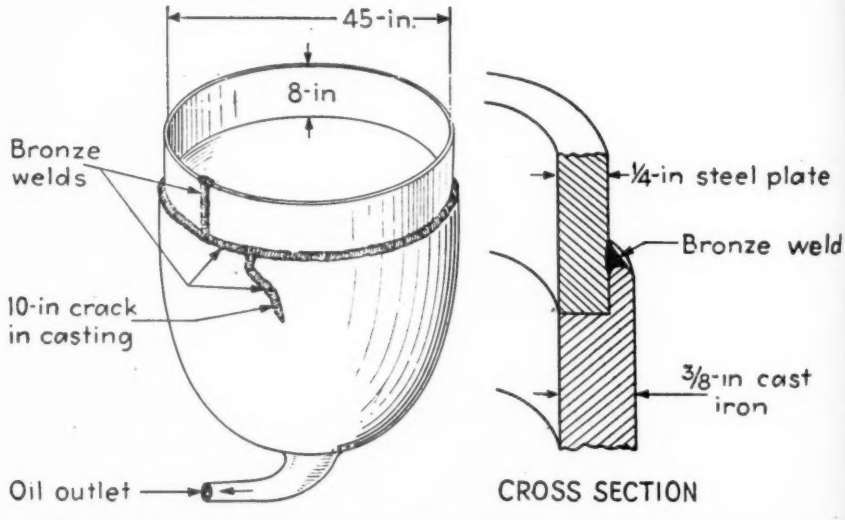
P 701.

OIL BLENDING KETTLE ENLARGED BY BRONZE WELDING

RECENTLY an oil refinery needed a kettle of greater capacity than the one they were using in certain oil-blending operations. When it was determined that a new kettle of the required size would not be available for some time, the problem was quickly solved by increasing the capacity of the one they had from 75 to 100 gal. through the use of bronze welding.

The iron casting of the original kettle was ⅜ in. thick and had a ¼-in. rabbet or shiplap around the inside of the top edge. A band 8 in. wide was cut from ¼-in. steel plate and bent to fit just inside the outer edge of the kettle rim and rest on the ¼-in ledge or rabbet. This fit made the inner surface of the added steel band flush with the inner surface of the cast iron kettle, and resulted in a lapping of the kettle rim over the outside of the steel band, such as in a fillet weld. The entire kettle was cleaned of any oil or residue before starting the hot work. Because of the necessity for clean surfaces in order to obtain good fusion in bronze welding, the edges to be welded were then ground and filed.

It was advisable to preheat the iron casting with the steel band set in place before welding to counteract the difference in the rates of expansion of the two metals and to avoid any possible stresses or cracks. A temporary firebrick furnace was built completely around the kettle and nearly up to the joint. Sheet asbestos was placed around the kettle from the top of the firebricks to the top of the steel band. Inside the kettle, charcoal was placed on a square mesh screen just below the joint in a pile around the wall about 4 in. deep and 6 in. wide. The charcoal fire was started with the blowpipe flame and a natural draft was supplied through the oil outlet at the bottom of the kettle.



A 75-gallon cast iron kettle was repaired and enlarged to a capacity of 100 gallons by means of bronze-welding. The sketch shows the details of the job and, in cross section, the method of joining the steel band to the cast iron.

The actual welding was done by one operator and took only about 6 hr. Oxweld No. 25M bronze welding rod ⅛ in. in diameter and Brazo flux were used for the job. A 10-in. crack that had developed previously in the top of the kettle was chipped out and bronze welded at the same time as the steel band.

The completed kettle was allowed to cool slowly before the removal of the preheat furnace and the sheet asbestos. ★★★

*Article courtesy Linde Air Products Company.

PAULSBORO TCC UNIT DESIGNED FOR TREATING OR REDUCED CRUDE CRACKING OPERATIONS

By **JOHN H. KUNKEL,** *Refinery Editor*

PART 1

FLOW AND PROCESS

EXCLUSIVE As a fountainhead grows into a stream, as a stream expands to form a river and, finally, as a river becomes the tributary feeding a vast ocean, so has catalytic cracking of crude grown from a small beginning to a tremendous flood of 100-octane gasoline pouring from America's refineries to engulf the Axis nations.

John H. Kunkel

The fountainhead of today's tremendous production of catalytically-cracked 100-octane base stock is the now historic Paulsboro, New Jersey, Socony-Vacuum Oil Company refinery. There, in 1930, Eugene Houdry conducted his final experiments that resulted in the commercial application of the catalytic cracking process bearing his name and there, in the spring of 1936, the world's first commercial Houdry plant went on stream.

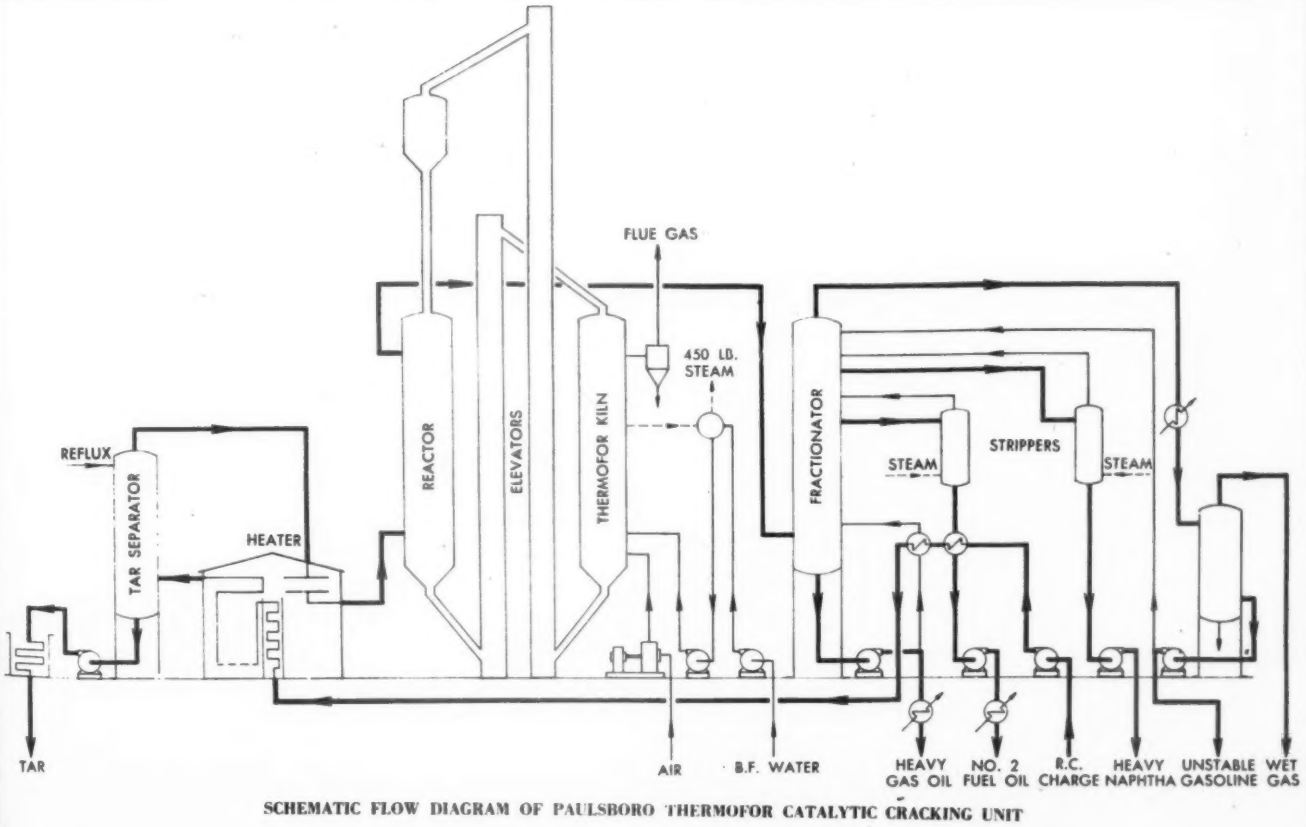
The original Paulsboro 3-case water-cooled Houdry unit has long since been dismantled. In March, 1940, it was replaced by the present case Houdry fixed-bed unit, which was augumented in August, 1944, by a thermofor catalytic cracking unit then placed on stream to re-treat in a second pass operation the distillate received from the fixed-bed Houdry unit.

The values obtained from treating catalytically cracked distillate in second pass have been very sufficiently established. These values are: Increased yield and a marked improvement in the anti-knock qualities of the fractionator overhead products. The practice is widely applied throughout the refining industry.

The TCC plant is the major unit of the 100-octane expansion program undertaken at Paulsboro by Socony-Vacuum and completed in August, 1944, and which, additionally, included an HF alkylation unit and a gas recovery plant.

Although at the present the TCC unit is applied to re-treating distillate for war use, as previously mentioned, it is so designed that, with only the addition of 2 lengths of transfer line, it can be converted for wartime or postwar operation on reduced crude. This conversion can be accomplished with the minimum down time. The unit was designed in collaboration with Socony-Vacuum engineers and built by The Lummus Company. It was placed on stream on August 25 at 3:00 p. m. and, after 3 shutdowns for minor mechanical modifications, it began a run of 2056 continuous hours that ended December 18, 1944. The unit was placed back on stream on Christmas day and has been on stream continuously to date.

In a once-through operation, the unit was designed to re-treat 7040 fifty gal. bbl. per stream day of first pass naphtha or, when operating on reduced crude, it was designed to process 19,670 fifty gal.



SCHEMATIC FLOW DIAGRAM OF PAULSBORO THERMOFOR CATALYTIC CRACKING UNIT

Courtesy the Lummus Company

bbl. per stream day. Currently, the unit is operating on a reactor charge totaling 10,100 fifty gal. bbl. per stream day, which is composed of 5550 fifty gal. bbl. of fresh feed and 4550 fifty gal. bbl. of recycle. At present, some of the unit's fresh feed is distillate received from a Houdry unit in Socony-Vacuum's Atlas works in Brooklyn, New York. Table 1 shows typical inspections of the Paulsboro TCC unit's feed and products.

In its current operation, the unit's products are wet gas and unstable gasoline, which are combined in the Paulsboro gas recovery plant to produce a debutanized 100-octane base stock, B-B feed for the HF alkylation unit, propane and propylene, and refinery fuel.

When cracking in postwar operations, the unit has been designed for flexible operations, which will produce unstabilized motor gasoline and wet gas as fractionator overhead, naphtha and/or furnace oil as side-streams and heavy gas oil as bottoms, the products produced being those best suited to the refinery operations then being conducted.

● **Re-treating oil cycle.** First-pass naphtha from the fixed-bed Houdry plant is charged into the TCC unit at atmospheric temperature and pressure through an electrically-driven, centrifugal 2-stage charge pump designed for a discharge pressure of 225 lb.* to a single-pass shell and 4-pass tube-type heat exchanger for preheating to a temperature of 360°F., the exchanger's hot medium being the desuperheating quench stream from the fractionating tower bottom.

Although now being used to re-treat distillate, the unit easily can be converted to crack reduced crude by the addition of only 2 lengths of transfer line.

The exchanger is designed for a duty of 12,490,000 B.t.u. per hr. The mean temperature difference is 131°F. On the tube side, there are 682 tubes, 16 ft. long by ¾ in. I.D. of 16-gage steel. The tube side operating pressure is 80 lb.

The preheated feed splits into 4 streams before entering the vaporizing furnace where its temperature is raised to 825-950°F. depending on the operation being conducted.

● **Vaporizing furnace.** The furnace is a standard Lummus baffled-gas-flow type designed for either treating or cracking service. It consists of 2 radiant chambers and a center down-draft convection section that contains low and high pressure steam superheating coils. The combustion chambers are floor-fired by 312 natural draft vertical gas burners and from opposed end walls by 24 natural draft air register type steam atomizing oil burners. When firing either gas or oil, the normal combined net heat liberating capacity of the burners is 111,000,000 B.t.u. per hr. The burners are designed for operation at 75 per cent and 125 per cent of normal rating with a maximum of 25 per cent excess air and maximum water column at the burner centerline draft of 0.15 in. The furnace contains an effective heating surface totaling 12,135 sq. ft. Table 2 details the furnace design capacity in cracking and treating service. Table 3 details the area and arrangement of the heating surface.

The flow arrangement for the oil coils is in 4 equal series streams with each stream passing in the following order: Upward through the convection section, thence to the radiant chamber passing upward through the side wall bank, across the lower roof tube bank, and back through the upper roof tube bank.

The flow through the low pressure steam superheating coil, situated at the top of the convection section, is a single series stream whereas the flow through the high pressure steam superheating coil, also in the convection section, is in 4 passes of 6 tube parallel.

Flue gas flow is directly downward from the convection section and thence beyond the heater steel framework through 3 underground ducts to the stack.

A feature of the furnace design is the fact that the heater hearths are approximately 7 ft. 8 in. above grade. Because of this, furnace heat cannot reach the ground and settling of the furnace structure, resulting from this source, is eliminated.

Leaving the furnace in split streams, the hot vapors combine in a single transfer line and go to the bottom of the reactor, which is described in detail under the subheading "Catalyst Cycle."

● **Fractionation.** Effluent from the top of the reactor flows through a 16-in. transfer line to the fractionator, entering it under its 19th deck at reactor temperature. The fractionator is 64 ft. 9 in. high and its I.D. is 14 ft. Its design pressure is 60 lb. and operating pressure is 15 lb. The fractionator contains 18 bubble decks on 30-in. centers and a bottom 19th deck with a ring-pipe sealring underneath that, in turn, feeds down to a flat baffle plate from which three

*All pressures are lb. per sq. in. gage.

TABLE 1

Typical inspections of feed and products.

Tests	Charge	Recycle	Gasoline	Fractionator bottoms
Gravity	48.6	31.3	57.0	11.7
Color	11	16+	30+	Green
RVP/pour			6.3	less than 0
MAP. PM. Fl.		84.9		156
Viscosity at 100				34.2
Acid heat	41		14	
I.P.	110	300	110	338
10 per cent	148	330	130	420
30 per cent	221	340	164	....
50 per cent	296	352	216	546
90 per cent	416	417	284	684
Rec. E.P. per cent	98 at 426	98 at 494	98 at 332	96 at 742
			Not inhib.	Inhib.
Acc. gum			6.1	3.0
AFD 1C+4. C. TEL	90.6		99.6	
AFD 3C+4. C. TEL	98.3		S+ 2.35	

TABLE 2

Vaporizing furnace capacity data.

	Cracking vaporizer service	Treating vaporizer service
Oil coil		
Throughput:		
B/D (42 gal.)	19,760	11,000
Lb./hr.	253,000	128,100
°API	28.8	45.4
Temperature in, °F.	450	325
Temperature out, °F.	815	1,000
Pressure in, lb. per sq in. ga. (calc.)	48	97
Pressure out, lb. per sq. in. ga.	20	17
Pressure drop, lb. per sq. in.	28	80
Vaporization, wt. per cent	66	100
Duty, B.t.u./hr.	76,450,000	73,000,000

Steam superheater coils	Cracking or treating service	
	L.p. steam	H.p. steam
Throughput, lb./hr.	5,000	65,000
Temperature in, °F.	373	463
Temperature out, °F.	850	560
Pressure in, lb. per sq. in. ga.	165	450
Duty, B.t.u./hr.	1,236,000	4,680,000

Efficiency

On the basis of the above services, the design overall thermal efficiencies, based upon a net heating value of 1,500 B.t.u./cu. ft. refinery gas fuel, or 17,800 B.t.u./lb. fuel oil, and an estimated radiation loss of 5 per cent, are as follows:

Cracking vaporizer service.....74.2 per cent
Treating vaporizer service.....75.0 per cent

12-in. pipes, each 6 ft. 5 in. in length, extend into the bottom head zone. The column contains a raschig ring-packed section in the top. It is pluramelt lined. The fractionator, as well as the tar stripper, was fabricated by the Sun Shipbuilding and Drydock Company.

The fractionator has 2 side stream draw-offs that feed 2 side stream strippers. In the treating operation, currently conducted, these strippers are not used but, in operation on reduced crude, they will be placed in service. In the treating operation, a recycle side stream bypasses the strippers to join the unit's fresh feed upstream of the vaporizing furnace.

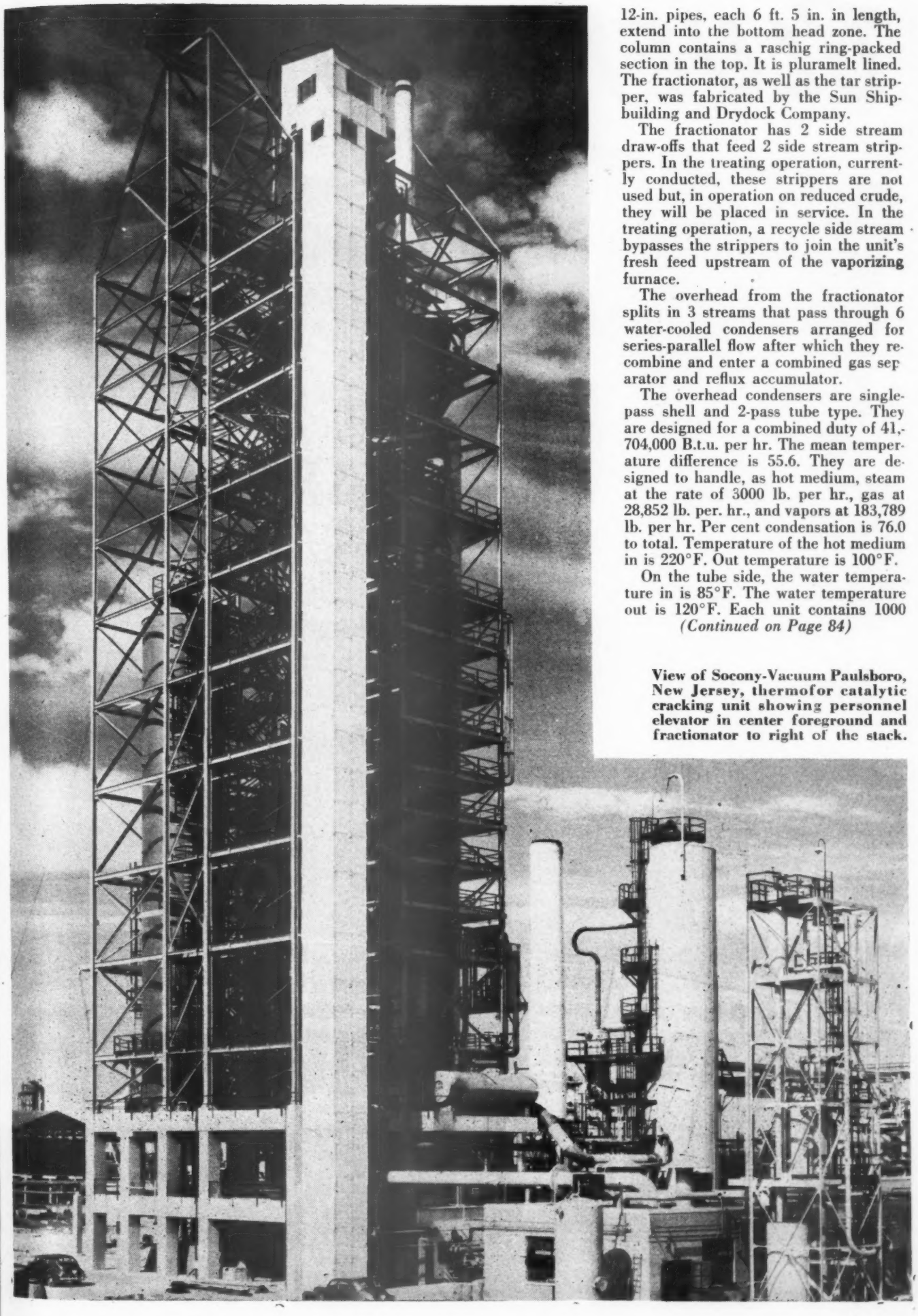
The overhead from the fractionator splits in 3 streams that pass through 6 water-cooled condensers arranged for series-parallel flow after which they recombine and enter a combined gas separator and reflux accumulator.

The overhead condensers are single-pass shell and 2-pass tube type. They are designed for a combined duty of 41,704,000 B.t.u. per hr. The mean temperature difference is 55.6. They are designed to handle, as hot medium, steam at the rate of 3000 lb. per hr., gas at 28,852 lb. per. hr., and vapors at 183,789 lb. per hr. Per cent condensation is 76.0 to total. Temperature of the hot medium in is 220°F. Out temperature is 100°F.

On the tube side, the water temperature in is 85°F. The water temperature out is 120°F. Each unit contains 1000

(Continued on Page 84)

View of Socony-Vacuum Paulsboro, New Jersey, thermofor catalytic cracking unit showing personnel elevator in center foreground and fractionator to right of the stack.



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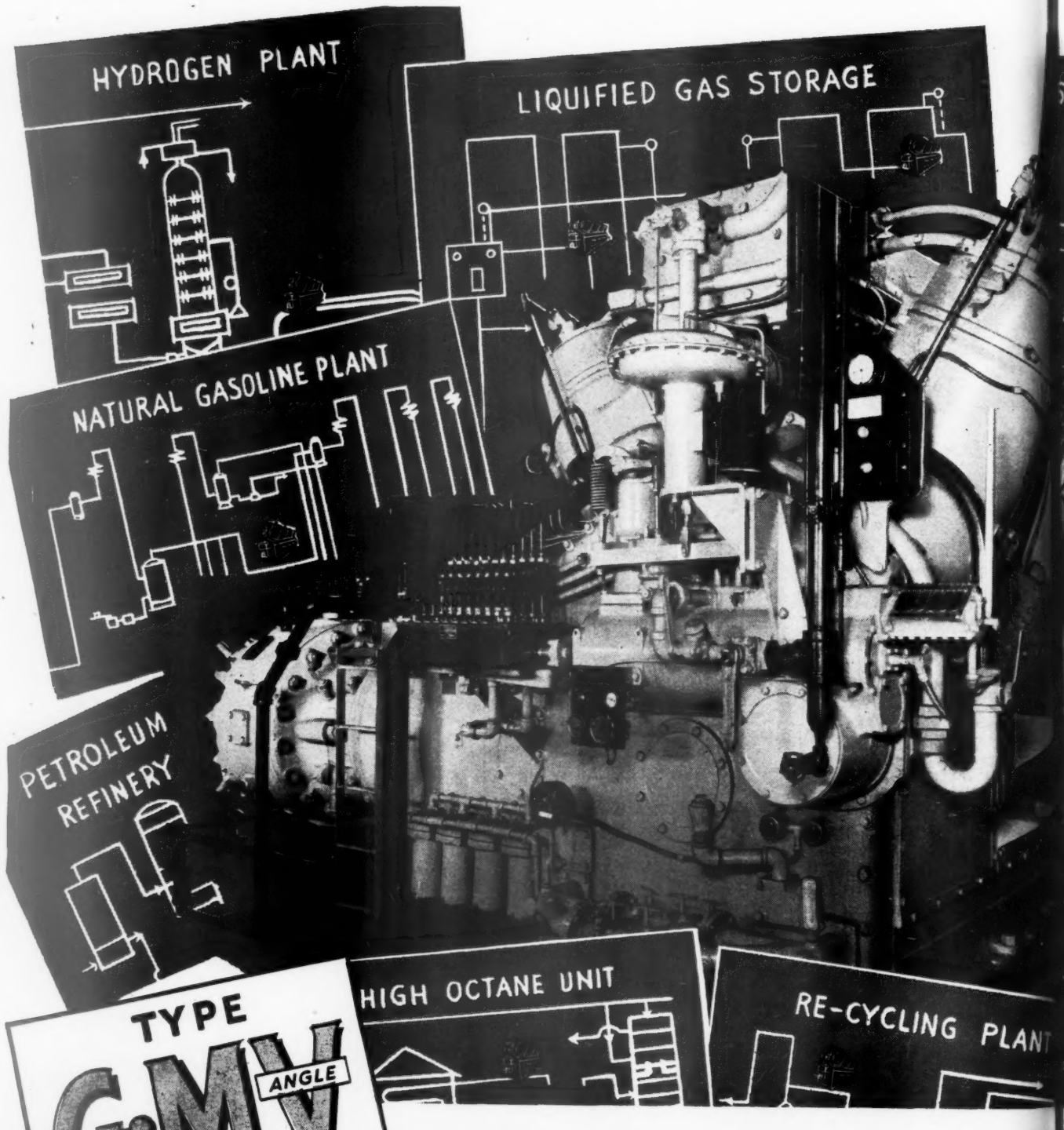

TYPE G·MV ANGLE

Compressors

New York Washington Bradford, Pa. Parkersburg, W. Va. San Francisco, Cal. Seattle, Wash

or those coming projects!

The green light for new plant construction is not far off. Priorities are coming off of many one-time critical materials and more will come off as the war's last battles are fought.

Every indication points to continued activity in the oil and gas industries:

1. **Depleted Reserves**
2. **Depleted Storage Stocks**
3. **Broadened use of Natural Gas**
4. **Resumption of Civilian Auto Travel**
5. **Increase in Aviation**
6. **Many New Petroleum Uses in the Chemical Field**

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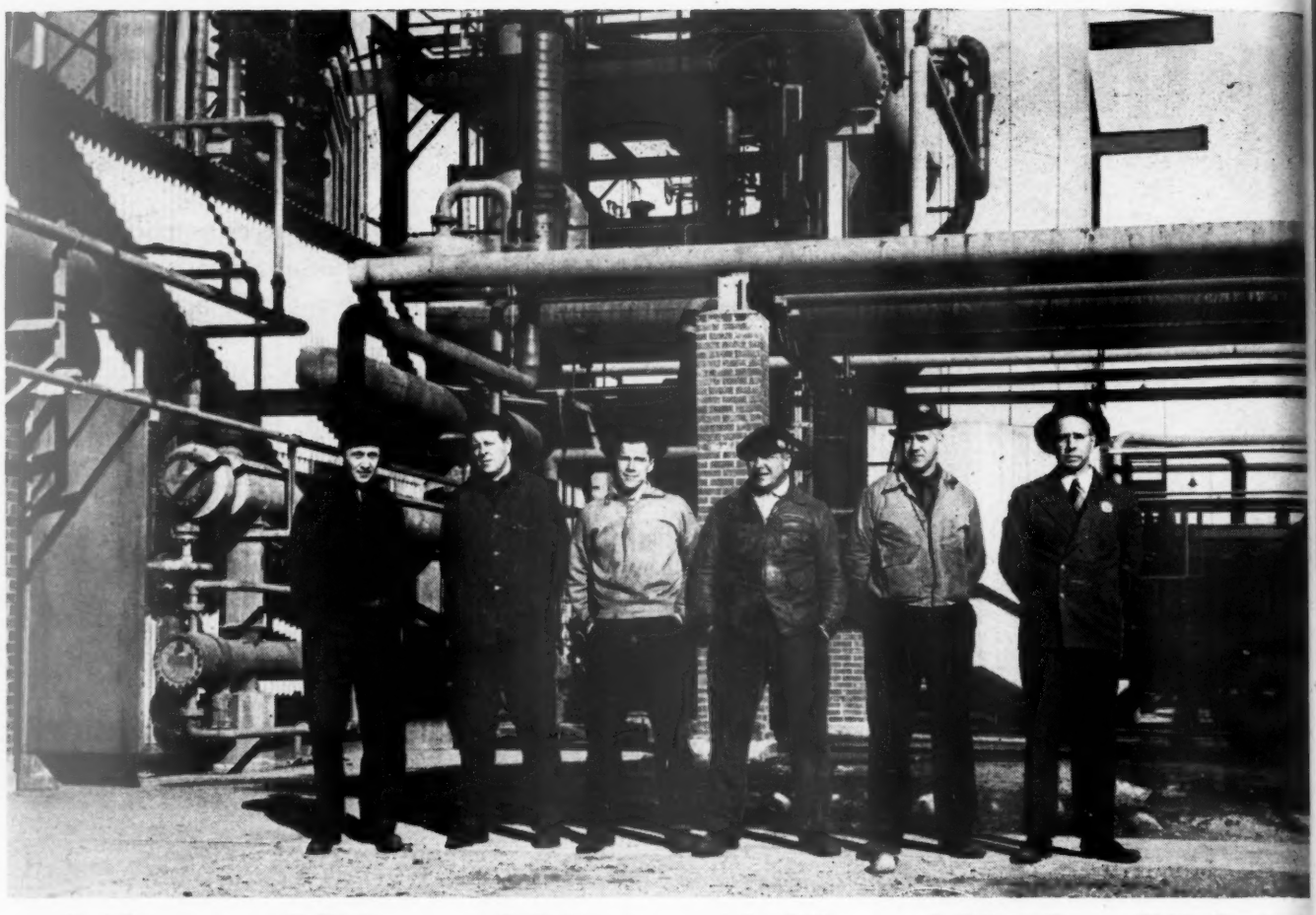


R. Arllen, *No. 4 Operator* | E. Magin, *No. 2 Operator* | E. Graham, *No. 5 Operator* | J. Landolfi, *No. 3 Operator* | J. O'Donnell, *No. 1 Operator* | M. MacKenzie, *Foreman*

TCC unit operators at the Paulsboro refinery.

(Continued from Page 81)

¾-in. 16-gage admiralty tubes 16 ft. long in a steel tubesheet. On the tube side operating pressure is 30 lb. whereas on the shell side the operating pressure is 5 lb.

Wet gas, overhead from the accumulator, goes to the gas recovery unit. Liquid, off the bottom, in part, refluxes the fractionator over its raschig ring section and the balance, an unstable distillate, goes to the gas recovery plant for finishing. In the gas plant the wet gas and unstable distillate recontact and are fractionated to produce a debutanized 100-octane base stock, a close cut B-B fraction for the refinery's HF alkylation unit, propane-propylene and a C_6-free dry gas for refinery fuel.

In the treating operation, to obtain maximum yield, the fractionator's side stream is recycled to extinction through the reactor, the recycle going to a surge drum from which it is pumped to join the fresh feed. Heavy fuel bottoms, in the recycle stream, amounting to approximately 5 per cent of the fresh feed are rejected.

Bottoms from the fractionator is a polymerized, low-gravity, low-viscosity fuel oil. A portion of the bottoms is used as a quench oil, which is pumped through a single shell, 2-pass tube, water-cooled cooler and thence back under the fractionator's 19th deck to desuperheat the effluent entering that column from the reactor.

The quench oil enters the cooler shell side at a temperature of 360°F. and leaves at 250°F. Water, through the tube side, enters at 85°F. and leaves at 120°F. The cooler is designed for a duty of 14,174,000 B.t.u. per hr. The mean temperature difference is 198°F. Operating pressures are: On the tube side, 30 lb.; on the shell side, 80 lb. The cooler contains 436 16-gage, ¾-in. by 16 ft. admiralty tubes in a steel tubesheet.

The net make of polymerized fuel oil bottoms from the fractionator is aftercooled and sent to fuel oil storage.

● **Reduced crude operations.** When operating on reduced crude, the flow is substantially that of treating operations with the following exceptions: Hot vapors and liquid tar from the vaporizing furnace will pass through a tar stripper where the tar is rejected, with the vapors then passing on through a superheater, where their temperature is raised to a cracking range of from 825-925°F. depending on the operation being conducted. On the fractionator side, the side stream strippers will be placed in service to handle naphtha or furnace oil as side products.

In reduced crude operations, normally there will be no recycle from the fractionator to the reactor. Only 2 connections will be required for the switch from treating to cracking, i.e., a connection from the hot vapor transfer line into the tar stripper and connection of the transfer line from the superheater to the reactor.

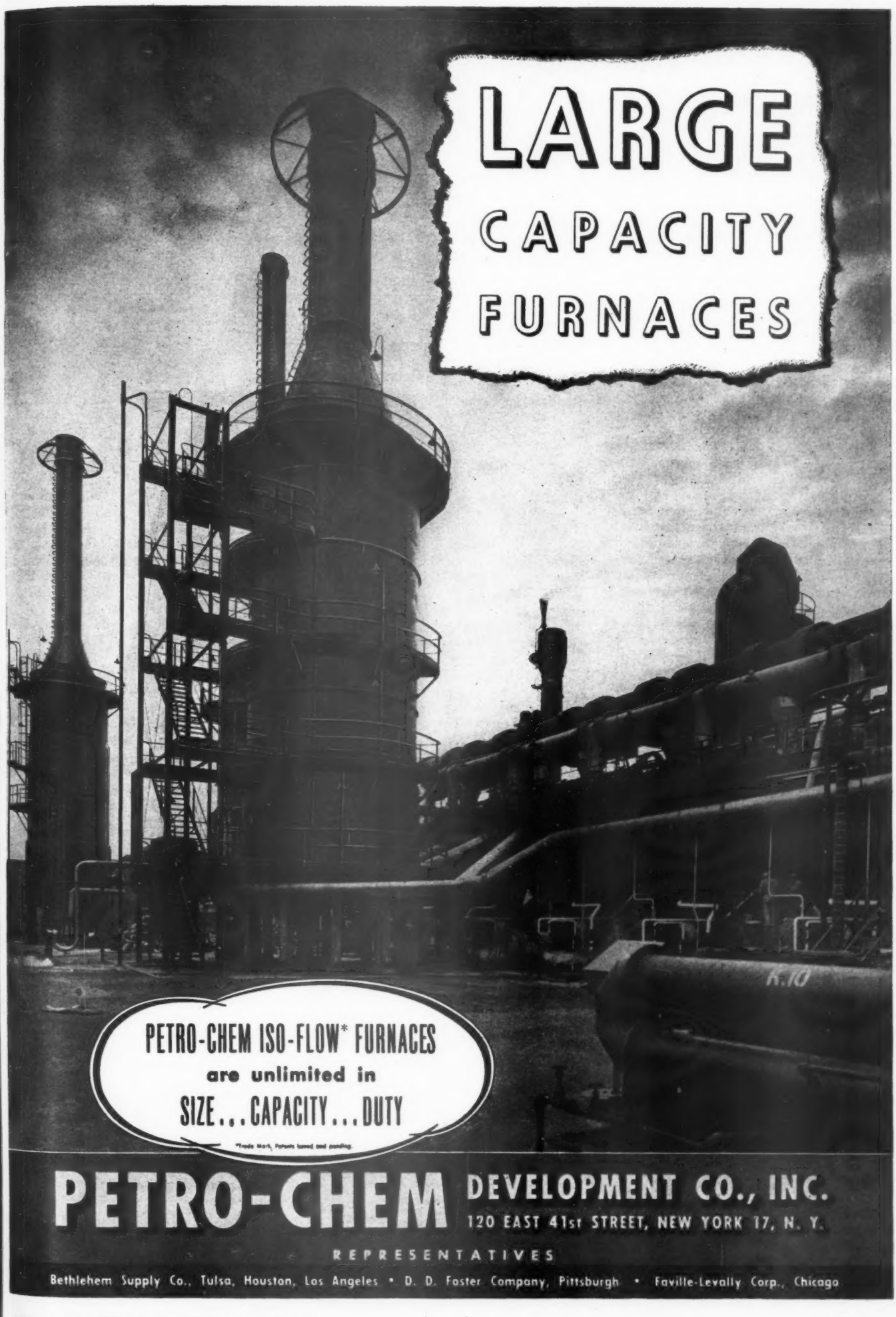
● **The tar stripper.** In cracking operations, the hot vapors and liquid tar from the vaporizing furnace will pass through the tar stripper, which functions to "clean" the vapors before they enter the superheater and the reactor.

The tar stripper contains 4 fractionat-

TABLE 3

Area and arrangement of vaporizer furnace heating surface.

Coil	Location	No. of tubes	Tube size, O.D. x min. wall	Effective surface (sq. ft.)
Oil	Convection	36	5" x ¾"	1,858
Vaporizer	Side walls	68	5" x ¾"	3,509
	Lower roof	36	7" x ¾"	2,610
	Upper roof	36	7" x ¾"	2,610
L.p. superheater	Convection	6	5" x ¼"	310
H.p. superheater	Convection	24	5" x ¼"	1,238
Total				12,135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ing decks, a draw-off pan for tower down-flow, and a squirrel cage tar separator in the flash zone. Design temperatures are: Bottom, 700°F.; top, 780°F.

Hot vapors from the vaporizing furnace enter the flash zone of the stripper and stripped vapors go overhead to the superheater. Tar bottoms go to a cooler from which part of the cooled tar is recycled to the stripper bottom as a quench to prevent coking in the bottom of the stripper. The net tar make from the cooler is pumped to storage. Provision is made for refluxing the tar stripper with furnace oil from the fractionator.

A special experimental provision is the installation of a hot pump and the necessary lines for the withdrawal of tower down-flow from the stripper's draw-off pan on the deck immediately above the flash zone returning it either to the stripper with incoming hot vapors, or mixing it with the fractionator bottoms before cooling and storage. The function of this provision is to permit closer fractionation in the stripper.

● **The superheater.** The superheater is a Lummus-type oil vapor unit for TCC cracking service. It consists of a single radiant chamber. The combustion chamber is fired by 72 natural-draft, vertical floor-firing gas burners and from opposed end walls by 8 natural-draft, air register-type steam atomizing oil burners. When firing either gas or oil, the normal combined net heat liberating capacity of the burners is 24,000,000 B.t.u. per hr. The burners are designed to operate at 75 per cent and 125 per cent of normal rating with a maximum of 25 per cent excess air and a maximum water column draft at the burner centerline of 0.15 in. Draft for the superheater's operation is accomplished through 5 interconnecting flues to the plenum chamber of the oil vaporizing furnace. Table 4 lists the superheater design capacity data.

TABLE 4

Vapor superheater capacity data.

Throughput:	
B/D (42 gal.)	11,000
Lb./hr.	136,600
°API	34.4
Temperature in, °F.	740
Temperature out, °F.	900
Pressure in, lb. per sq. in. ga.	17
Pressure drop, lb. per sq. in. ga. (max.)	2
Duty, B.t.u./hr.	16,000,000

Efficiency

The design thermal efficiency of the superheater is 66.6 per cent based upon the net heating value of 1,500 B.t.u./cu. ft. refinery gas fuel or 17,800 B.t.u./lb. fuel oil and an assumed radiation loss of 5 per cent.

TABLE 5

Area and arrangement of vapor superheater heating surface.

Location	No. of tubes	Tube size, O.D. x wall	Effective surface (sq. ft.)
Drying pipes (plenum chamber)	8	12" IPS	1056
Upper roof	20	7'-0" x 0.375" MW	1450
Lower roof	20	7'-0" x 0.375" MW	1450
Total			3956

The flow of vapors through the superheater is in 4 equal and symmetrical streams with the vapors flowing in series through two 12-in. I.P.S. drying pipes, and thence in parallel flow through 2 passes of 7-in. O.D. by 3/8-in. minimum wall tubes. The first pass through the heating tubes is through the upper horizontal roof row, whereas the second pass is through the lower horizontal roof row. The superheater contains a total of 3956 sq. ft. of heating surface. Table 5 details superheater tube data and heating surface arrangement. As in the case of the vaporizing furnace, the superheater is elevated 7 ft. 8 in. above grade.

● **Catalyst cycle.** A synthetic bead catalyst, manufactured in a plant in the Paulsboro refinery, is used. The beads are spherical in shape and approximately the size of a small pea.

The TCC units are: A reactor, and a regenerator with a pair of bucket elevators one of which transfers catalyst from the base of the reactor to the top of the regenerator, whereas the second transfers regenerated catalyst from the bottom of the regenerator to the top of the reactor catalyst hopper. The TCC process, therefore, is continuous and the catalyst is constantly in circulation.

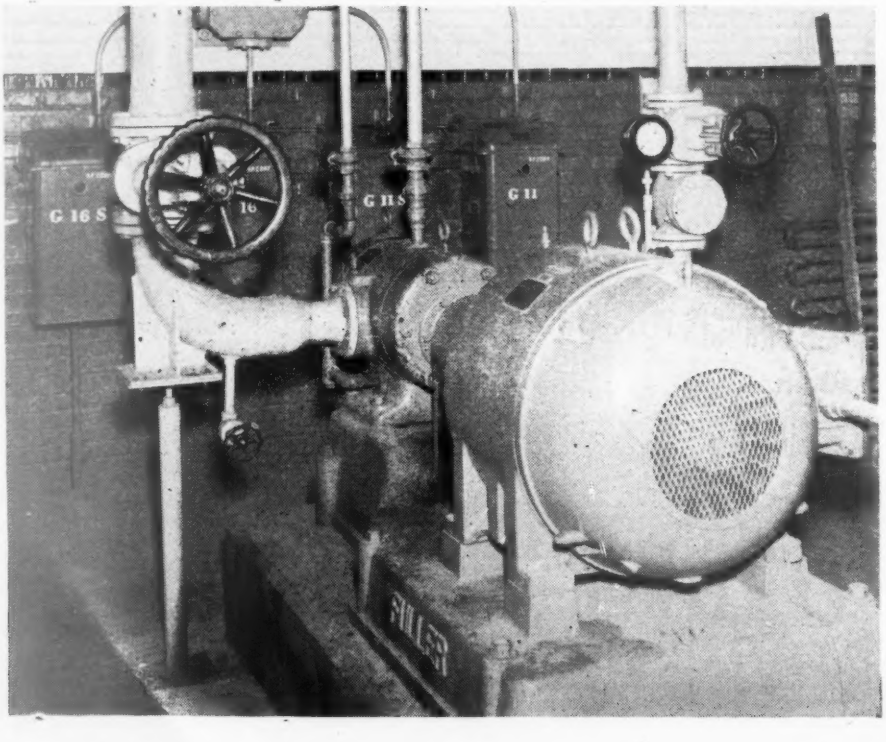
The reactor, as a unit, consists of a catalyst hopper that is positioned about 75-80 ft. above the reactor vessel with a feed leg connecting them. The hopper operates at atmospheric pressure.

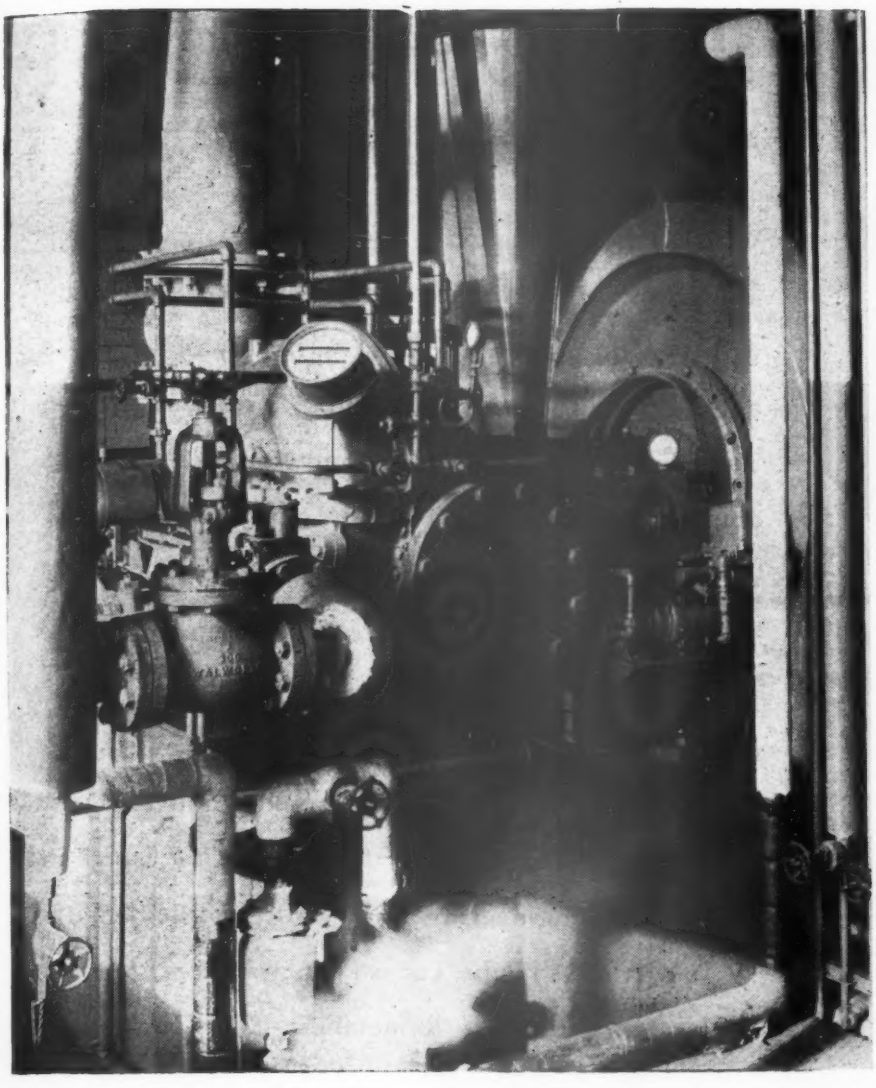
The height of the reactor vessel is 57 ft. 3 11/16 in. Its I.D. is 16 ft. Descriptively, it may be said to contain 3 sections, i.e., a top drum or catalyst distribution section; a reaction section that includes the effective catalyst bed and vapor disengaging space, and a funnel-shaped bottom section from which catalyst is withdrawn continuously for regeneration.

Catalyst, at a temperature of 825-900°F., flows by gravity from the hopper down the feed leg and continuously into the catalyst distribution section of the reactor. This section has been carefully designed to provide for, and maintain, equal distribution of catalyst across the entire diameter of the reactor. To assure such distribution a concave plate, from which feed pipes extend downward into the reaction section, is positioned across the reactor, The catalyst distribution is substantially full at all times, and the required equal distribution is effected by the number and positioning of the feed pipes and the concave shape of the plate.

● **Reaction section.** The reaction section contains an effective catalyst bed 35 ft. deep holding 7000 cu. ft. of catalyst. Hot vapors from the vaporizing furnace when treating, or from the superheater when cracking, enter the reactor beneath the effective bed through a vapor inlet grid designed to insure equal distribution of vapors across and through

Rotary compressor, motor driven.





Air blower on Paulsboro TCC unit showing turbine drive.

the effective bed. Vapors flow at low velocity countercurrent to the downward moving catalyst and leave the reactor through outlets positioned in the generous vapor disengaging space underneath the concave distribution plate. The reaction section operates at a pressure of 10-12 lb.

As the catalyst hopper operates at atmospheric pressure, and, therefore, slightly higher than that of the reaction section, a seal is required at the top of the vapor disengaging space to prevent hydrocarbon vapors from entering the catalyst distribution section, the feed leg, and catalyst hopper.

To effect this seal, oxygen-free flue gas is introduced into the reactor underneath the distribution plate through an automatic controller that maintains a constant and positive pressure differential between the catalyst distribution section and the vapor disengaging space. As the pressure in the distribution section is maintained by a controller at a slightly higher level than the pressure in the vapor disengaging space, there will be a slight but continuous flow of flue gas from the distribution section into the vapor disengaging space, preventing any flow of hydrocarbons into the distribution section, and effectively directing the flow of hydrocarbon vapors through the outlets in the vapor disengaging space to the transfer line leading to the fractionator.

At the same time, because the catalyst hopper operates at atmospheric pressure, there is a small but steady flow of flue gas up the feed leg countercurrent to descending catalyst.

The funnel-shaped bottom section of the reactor contains a steam collecting grid (currently not used), 4 catalyst outlet baffle plates, each of reduced diameter, and a stripping stream inlet positioned beneath the top baffle plate. The baffle plates are equipped with downpipes so positioned that, in combination with the funnel shape of the bottom, the rate of catalyst flow across the entire cross-sectional area of the reactor is uniform. The superheated stripping steam, at a temperature of 850°F. and at a pressure of 15-20 lb. serves to remove oil vapors occluded within the catalyst pores.

As a result of reaction, coke is deposited on the catalyst as it flows downward through the reaction section, necessitating regeneration. Catalyst is withdrawn from the bottom section of the reactor by a continuously operating chopper-type valve that also serves to govern the catalyst level in the hopper and the rate of catalyst feed into, and rate of catalyst flow through, the reactor.

Catalyst released from the reactor by this valve flows by gravity down a pitched line to a depressuring pot, which contains a jet condenser operated at atmospheric pressure that functions to flash off and condense steam and reject the condensate. From the depressuring pot, the catalyst flows by gravity through a pitched line to the kiln feed elevator.

● **Velocity; ratio definitions.** On the basis of 10,000 bbl. per stream day the unit is designed for a treating space velocity of 0.35, which is defined as the liquid volume of oil per volume of catalyst in the reaction zone per hr.

The catalyst to oil ratio is 1.7, which is defined as volume of catalyst circulated per liquid volume of oil charged to the reactor per unit of time. The catalyst to oil ratio is maintained by the elevator throughput and feed rate.

On reduced crude, the rate of cracking is principally controlled by varying the inlet temperature of the reactor feed. Secondary control, however, can be effected by varying the temperature at which the regenerated catalyst is returned to the reactor.

● **Catalyst regeneration.** Catalyst, at the rate of 100 tons per hr., is circulated through the Paulsboro TCC unit under present operations, but the rate can be raised to 130 tons per hr.

Catalyst for regeneration flows from the depressuring pot by gravity through a pitched line to the thermofor kiln feed elevator and up over the top of the kiln. The kiln feed elevator and the reactor

SAE to have section meetings

Local sections of the Society of Automotive Engineers have set up a program of local war emergency meetings to disseminate essential war-engineering information, SAE General Manager John A. C. Warner has announced. The new series of meetings has been designed to aid members until the end of the war when national meetings will be resumed.

Plans call for the presentation of technical papers at one-day local section meetings throughout the country. These papers were originally scheduled for SAE national meetings. Copies of all papers will be made available to society members. Subsequently, they will be published, either complete or in abstract, in the *SAE Journal*, official publication of the organization.

If the War Committee on Conventions should lift the ban on national meetings, SAE will again resume its national meetings program, Warner said.

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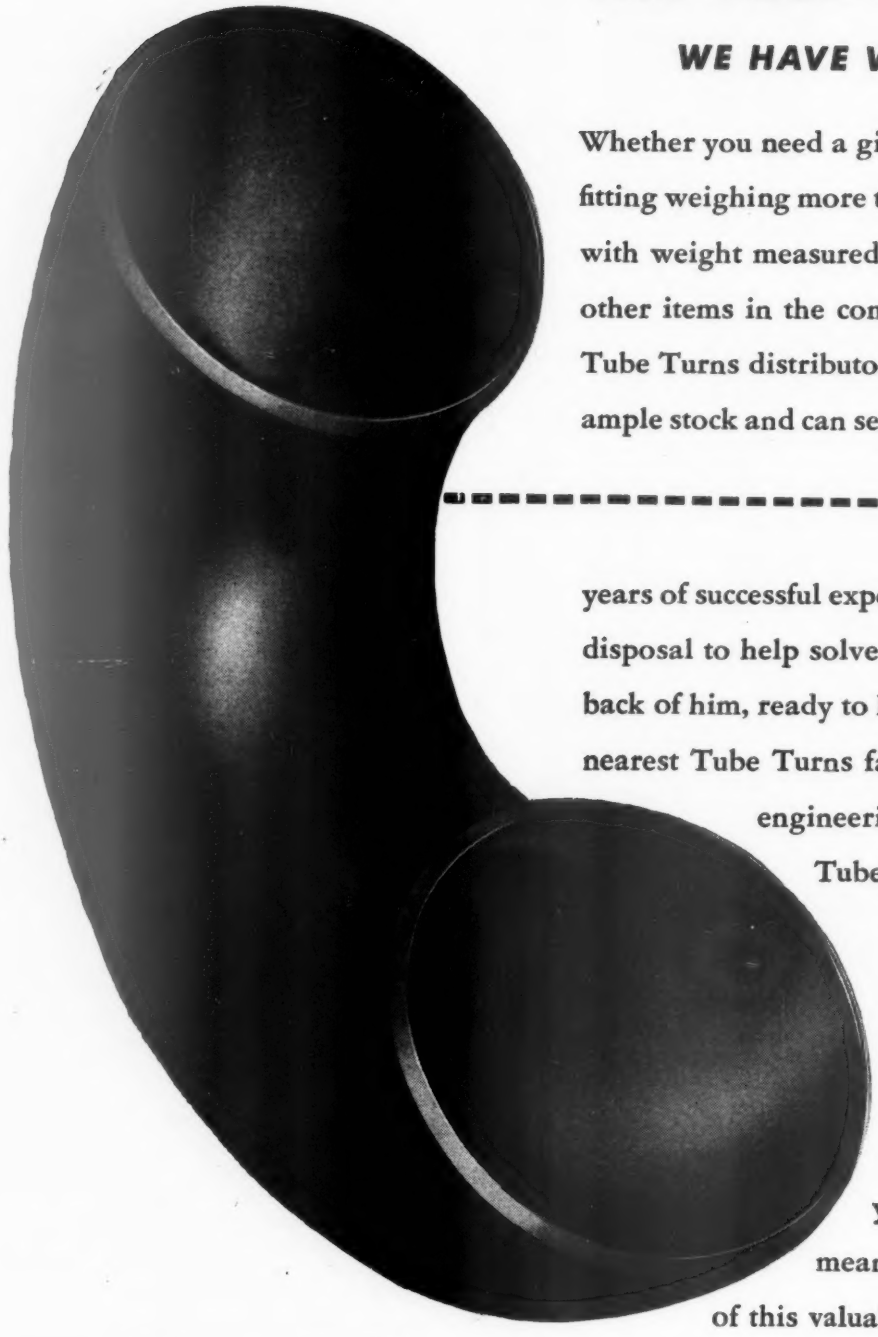

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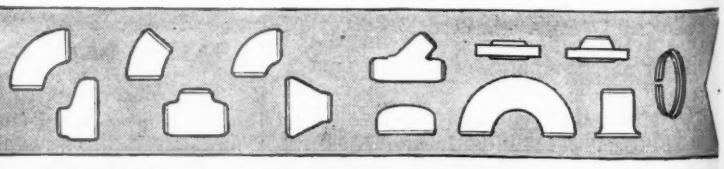

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feed elevator are described in detail in the second installment of this article.

The thermofor kiln unit consists of an elutriator for the elimination of catalyst fines and rejection of flue gas positioned above and connected to the kiln proper by a flue gas duct. The overall height of the unit is 238 ft., whereas the height of the kiln proper is 120 ft. 1¼ in. The kiln is 10 ft. 3 in. square and its sides are of suspended refractory tile.

The kiln is catalyst-filled at all times. The flow of catalyst for regeneration is continuously downward through 10 alternate burning and cooling zones and out of the kiln through a chopper-type valve by gravity and via the reactor feed elevator back to the top of the reactor catalyst hopper.

Two air ducts, carrying preheated air at a temperature of 600-1000°F. from an airline burner, lead up two sides of the kiln. An air inlet grid is positioned in each burning-cooling zone. Two flue gas ducts lead up the side of the kiln with flue gas collecting girds and dampers positioned in each zone. A circulating water header serves on the third side to feed 2 horizontal rows of cooling tubes and a steam and water header serves the fourth side. The kiln, however, has 5 extra tube sets in the base so that the temperature of the catalyst can be reduced, if operations require, to a level lower than that of the other zones. This contributes to the unit's flexibility and, as previously stated, decrease of the catalyst temperature at this point is one means of controlling the rate of cracking.

Superheated combustion air from the air ducts flows into each burning zone under careful control, the resulting combustion, caused by contact of the hot catalyst and the lower temperature, though superheated air, burns the coke from the catalyst. Flue gas, as a product of combustion, flows through the collecting grids and through the flue gas duct to the elutriator.

The catalyst residence time in each burning zone is controlled by the rate of catalyst throughput. In current operations, on the basis of a catalyst throughput of 100 tons per hr., the catalyst residence time in the first 9 zones is 7 min. per zone. The residence time in the deeper 10th zone is 20 min. The height of a zone is defined as the distance between flue gas outlets.

Burning can be accomplished effectively only within narrow temperature limits in each zone. The upper limit is the scorching temperature of the catalyst; the lower is that at which combustion ceases. Thus, only a certain percentage of the total coke deposit is burned in each zone.

The rate of combustion in each burning zone is closely controlled by carefully regulating admission of the preheated air so that the temperature rise in that zone is not excessive.

Catalyst passes from the burning to the cooling zone, which contains the steam generating coils where the catalyst is cooled to a temperature as low as can be attained without delaying further combustion in the next zone. As previously mentioned, regenerated catalyst from the kiln bottom is returned to the reactor catalyst hopper by means of the reactor catalyst feed elevator.

The elutriator, positioned above the kiln proper, functions to eliminate catalyst fines. This is accomplished by constantly circulating about 5 per cent of the total catalyst circulation through this unit. A drag stream leads the catalyst by gravity from the reactor feed elevator to the top of the elutriator where flue gas, from the kiln, passing through jets carries the fines out of the top of the elutriator to enter 6 cyclone separators at the top of the structure. The cyclone separators collect the catalyst fines, which flow by gravity to a special bin. Normal size beads drop to the bottom of the elutriator from which they flow by gravity into the top of the kiln through a special line.

● **Thermofor kiln steam and water system.** Treated boiler feedwater, received from the refinery, is pumped from a surge tank by a centrifugal single-stage electrically-driven feed pump at a maximum rate of 100,000 lb. per hr. and at a discharge pressure of 60 lb. through the deaerator vent condenser as a cold medium and thence to an 8-ft. by 3-ft. vertical deaerating feedwater heater where 35-lb. exhaust steam from pump drives preheats the feedwater to a temperature of about 270°F.

A main high-pressure turbine-driven, centrifugal 4-stage feedwater pump takes suction from the deaerator and, at a pressure of 450-500 lb., discharges into the main kiln high-pressure steam drum where the feedwater temperature is elevated to about 458°F. The steam drum is 5 ft. in diam. by 20 ft. long.

An electrically-driven centrifugal single-stage kiln water circulating pump takes suction from the steam drum and, at a pressure of 465 lb., circulates the water through the various coils in the kiln cooling zone. The capacity of the kiln water circulating pump is large enough so that 3 to 10 times as much water can be circulated as steam is generated. Thus, the per cent vaporization per pass through each coil is held to a low figure preventing sealing and eliminating difficulties that may arise in case of sudden fluctuation in the heat load.

Partly vaporized water at a temperature of 460°F. from the coils returns to the kiln steam drum where the steam generated separates from the water. A continuous blowdown is drawn to maintain a low solid content in the steam drum.

A 300-hp. condensing turbine-driven centrifugal single-stage air blower supplies combustion air at the rate of 21,000 s.c.f.m. and a pressure of 2.5 lb. to the kiln with a bypass so arranged that all or none of the air can be passed through the air heater. The air heater, essentially, consists of a closed shell with an oil burner. The air is heated to the desired temperature in the range of from 600-1000°F. The heated air enters the risers, which extend to the top of the kiln, flowing into the burning zones through inlet grids. ★★★

This is the first of a series of three articles by Mr. Kunkel on the Paulsboro TCC unit for treating or reduced crude cracking operations. The second one on catalyst elevators will appear in an early issue.

Lago refines billionth barrel in Aruba

The employes of probably the most blacked-out and isolated American war plant in existence recently celebrated an unmatched production record, the processing of a billionth barrel of crude oil. The accomplishment was observed by the 6500 employes at the refinery of Lago Oil and Transport Company, Ltd., a subsidiary of Standard Oil Company of New Jersey, on Aruba in the Dutch West Indies. The refinery has been operating 16 years.

Aruba has been described by Standard officials as a mere dot of an island lying off Venezuela, without fresh water, large trees, vegetables, or any other pastoral aspects of nature. Nearly every basic commodity of living must be imported.

Crude oil from nearby Venezuelan fields is transported to Aruba by tanker. Standard officials point out that the availability of Venezuelan crude, and splendid cooperation of the South American country with the United Nations' war effort, have been major factors in the ability of the latter to meet the war demand for oil products. Lago's workers, who include 600 Americans, have continuously refined 100-octane gasoline and other vital war petroleum products under strict dimout. Total blackout prevailed during 9 months of operations, immediately after the night of February 16, 1942, when a German sub surfaced and shelled the island and harbor. One tanker was sunk, another was disabled, but the refinery was unscathed. Aruba donned a coat of battle gray—towers and storage tanks were repainted and all lights were totally hidden.

The strategic importance of the established refining facilities on Aruba when war broke has made its modern oil refinery of focal importance to the entire war program, and it has been producing at capacity since before Pearl Harbor. Essential new supplementary units were put into operation 9 months after construction had been started. New war requirement quotas have been passed regularly, according to Standard officials.

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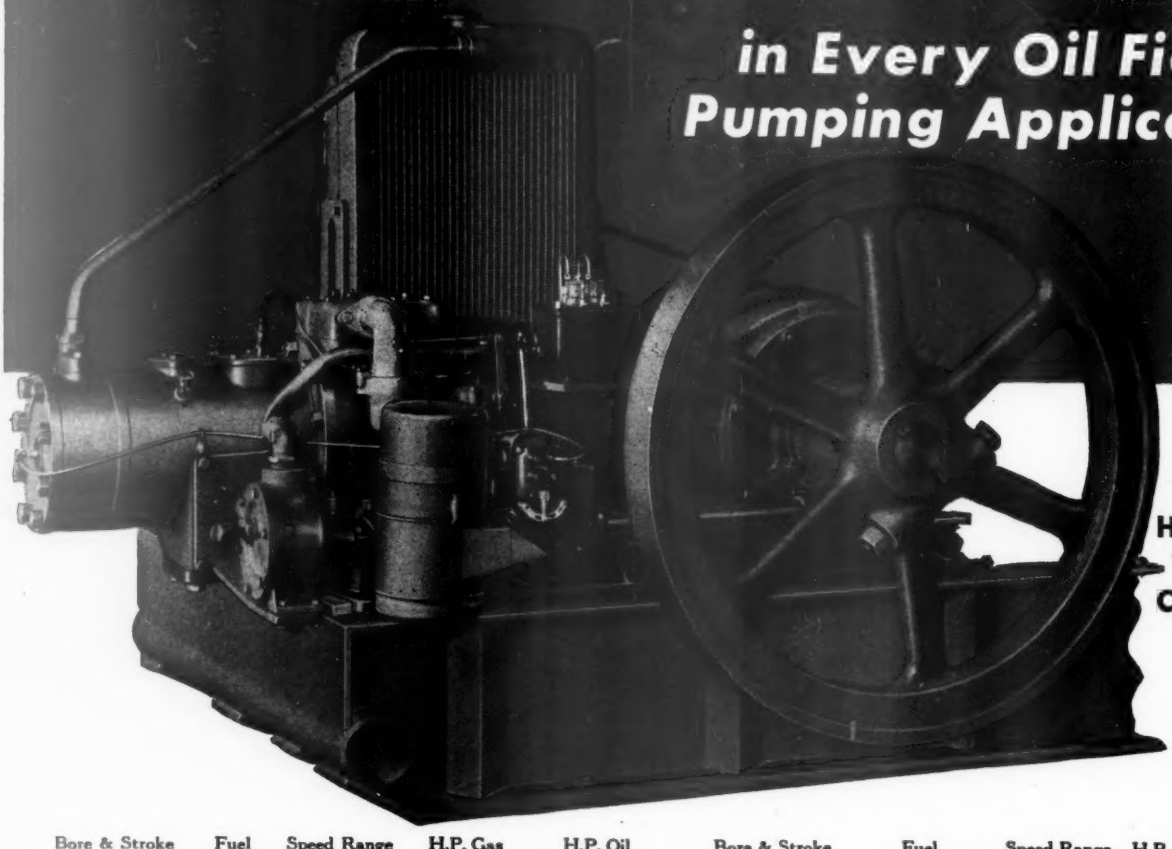

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7¼ x 8	Gas	300-600	22½ @ 600	.....
7½ x 10	Gas or Oil	250-500	25 @ 500	20 @ 500
8½ x 10	Gas	250-500	33 @ 500	.....

Bore & Stroke	Fuel	Speed Range	H.P. Gas	H.P. Oil
10½ x 13	Gas or Oil	200-300	25-38	22-33
11 x 14	Gas or Oil	200-300	30-45	26-40
12 x 15	Gas or Oil	200-300	40-60	35-51
13¼ x 16	Gas or Oil	200-300	50-75	44-66

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CASING SHOE IS DESIGNED TO PROTECT OPEN PAY ZONE

By **K. MARSHALL FAGIN,** *Field Editor*

CEMENTING off permeable pay zones left open below the casing point is one of the hazards usually confronted in completing a well. To guard against this possibility a new device in the form of a special casing shoe* has been developed. Its purpose is to assure the maximum initial and ultimate oil and gas production by preventing the accidental blocking-off of saturated strata when cementing the production string. It combines a regular drillable guide and float valve assembly with a double rubber full hole packer. A bridging ball is used to expand the packer and open upper side ports that direct the flow of cement outward and upward around the casing. When set against firm formation, the packer is designed to prevent any cement from entering or sheathing any permeable layers of the pay zone that were drilled and left exposed below the shoe. Thus, the employment of this device is intended to provide mechanical insurance that cement will not interfere with the successful completion of new oil and gas wells.

*The Cementrol casing shoe manufactured by Larkin Packer Co., St. Louis, Mo.

● **Employed in West Edmond.** Several of the larger operators in the West Edmond field have recently reported effective use of this shoe in their efforts to pack off open pay formation below the casing point and place the cement up around the casing. This new tool with its "built-in turning point" and packer, is shown in Fig. 1.

● **Description of shoe.** The lower part of the shoe contains a regular bakelite guide and back pressure valve. Above, on the outside, are two packer rubbers separated by a sliding steel wedge ring. Immediately above are four keyhole-shaped slots in the shoe. These slots are covered internally with a bakelite sliding sleeve-type valve consisting of an inverted valve seat that is fastened with shear pins to a sliding metal outer sleeve that rests on top of the packer rubber. Fluid cannot pass through these four keyhole-shaped ports so long as the sleeve valve remains pinned in the original position. Rubber gaskets are inserted in the bakelite sleeve to prevent mud or cement from bypassing the sleeve. A slip type lock inside the upper steel sleeve prevents it from sliding back up, partially closing the ports, and relaxing the rubber packing, after the packers have once been set. The bakelite valve sleeve has a seat for the bridging ball, which is dropped or pumped in from the derrick floor when the shoe is in position to be set at the casing point.

● **Method of setting.** When the lead-weighted bakelite bridging ball reaches the seat in the top of the inside bakelite sleeve valve, a pump pressure of 200 to 300 lb. is sufficient to force the inside and outside sleeves downward, setting the packing rubbers against the wall of the hole. Then, when the mud pump pressure builds up to 800 or 900 lb., the pins that tie the two sleeves together are designed to shear, allowing the inside bakelite sleeve to slide down to the top of the bakelite back pressure valve and open up the four side ports. With the side ports open, the mud pump pressure should drop to normal for circulation down through the casing and up around the outside annular space to the surface.

FIG. 1. Drawings of the new casing shoe showing: left, how the shoe appears in position to set, and right, how bridging ball has operated to pack off the bottom of the hole before cement is run.

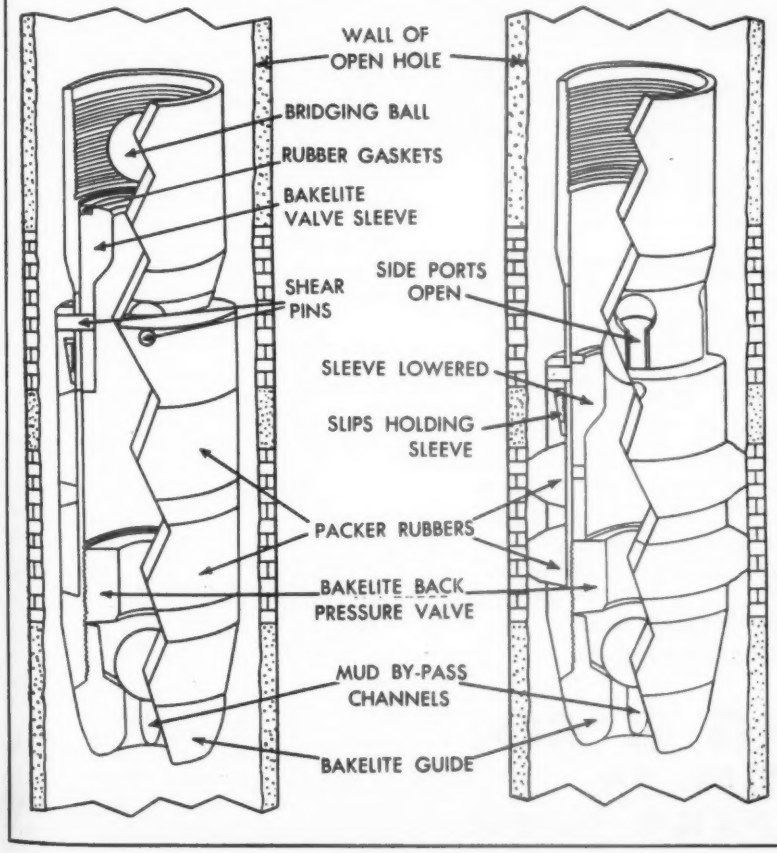
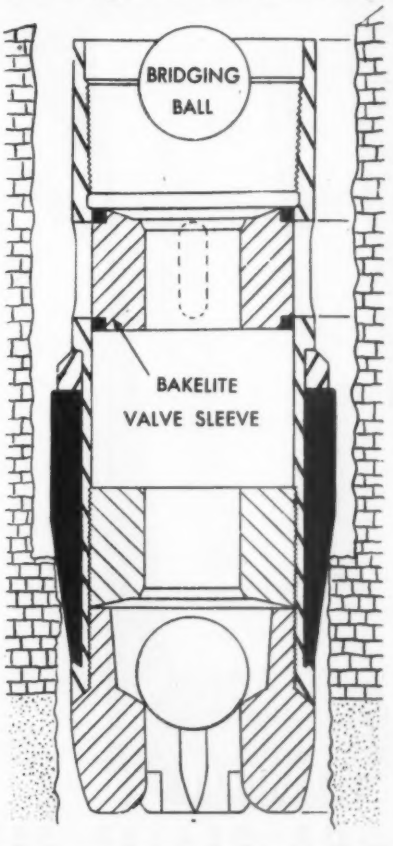


FIG. 2. Cut-away view of the formation pack float shoe landed against shoulder of a rat hole. Bridging ball is dropping to seat in top of bakelite valve sleeve.



From this point on, the cementing operation is carried on in the usual way except that a back pressure must be held on the casing after the cement is placed. Holding pressure is necessary because no back pressure valve can be run above the shoe, for it would interfere with the downward travel of the bridging ball. A baffle collar would not interfere with the ball, however, and may be run at any desired distance above the shoe to stop the cement plug.

● **Other means of protection.** Prior to the development of this new casing shoe some of the accepted ways to avoid the danger of cementing-off any of the permeable portions of the pay zones were: (1) To stop drilling and set casing a safe distance above the estimated top of the pay zone; then, drill the plug and complete the well in the usual manner; (2) To set a special packer or bridge plug in the open hole below the casing point before running casing, or (3) To spot heavy mud mixed with cotton seed hulls or special fibrous materials in the bottom of the hole before setting the pipe.

The first precaution is not usually possible on wildcat wells, because the pay zone is generally penetrated before the casing point is selected. It is likewise difficult to apply in fields where the top of the pay zones are irregular or faulted, but in many fields it has provided adequate protection. The second method has served widely and with generally satisfactory results for years. The third precaution is credited with partial to good protection against clean-out jobs.

Employment of the new shoe offers a new method of cement control. Its performance in the field will determine its relative place among the customary practices. Experience has shown that without proper adoption of one or more of these precautionary measures, cement is occasionally washed a considerable distance below the shoe and sets up against, or possibly in, the permeable oil and gas strata, displacing the drilling mud.

It is very difficult to estimate the actual amount of plugging that a cement sheath or infiltration may cause in a given well. In some cases, the cement may not noticeably reduce the initial production of a well, but in many others there is often good reason to believe the initial production would have been better if a method of keeping cement out of the producing zone had been employed. In a few instances, vain attempts have been made to obtain commercial production from wells that showed oil on drill stem tests, but apparently were completely plugged off by cement.

● **Shoe designed to obtain high potentials.** The problem of obtaining the maximum initial production from new wells in the Arbuckle lime formation of western Kansas was one of the reasons this new casing shoe was developed. The higher the initial production, the higher the allowable granted by the state regulatory body, and the faster the payout. Even though some operators were taking precautions to guard against it some were having occasional difficulty with cement reaching the upper and frequently very permeable portion of the Arbuckle formation. Most of the trouble seemed to stem from the practice of rat-holing ahead below the casing point, in order to drill-stem test to be sure the production merited setting a string of pipe.

The first style of the new type shoe was developed as a solution at the suggestion and with the aid of various oil companies' engineers. It was designed with a single tapered rubber packer reinforced with wire mesh that would slip into the rat-hole and pack-off as the shoe came to rest against the shoulder. The "built-in turning point" incorporating a bridging ball and a sleeve type bakelite valve was used together with mud pump pressure to uncover the side ports. This design (Fig. 2) is in use and is currently available for wells where operators wish to set casing against a shoulder. Later, the full-hole type packer shoe was introduced experimentally. It had only one rubber packer and after field trials was replaced by the present model with a double rubber packer.

Although failures of this new type shoe are inevitable due to irregular or caving hole conditions or very low formation pressures that may cause packer failure, the device marks an interesting development as a further means of overcoming well completion difficulties caused by cement intrusion into open formations below the casing seat. ★★★

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Fig. F533 Fig. F538

SPANG TUBING SPEAR
(Fig. F533)

SPANG TRAP SOCKET
(Fig. F538)

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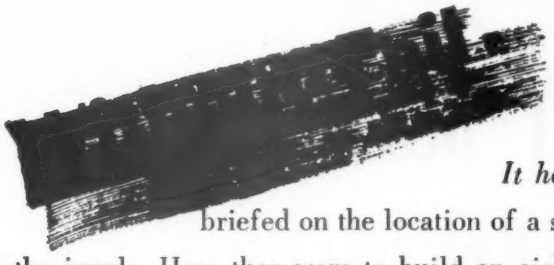

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WORLD'S LARGEST BUTADIENE PLANT TOPS EXPECTATIONS

EXCLUSIVE At Port Neches, on the Texas Gulf Coast, the largest butadiene plant in the world has been in operation for a year. Exceeding expectations, this enormous 314-acre plant has demonstrated a production capacity 40 per cent greater than its rating. To illustrate the magnitude of the project, capacity operation is equivalent to the production of 30,000,000 peacetime passenger car tires a year. The product butadiene, a major component of synthetic rubber, has always exceeded the rigid requirement of 98.5 per cent purity. Its cost, at Neches, is so low that the final synthetic rubber will cost only about one-half as much as the prewar price of natural rubber, and only one-quarter as much as synthetic produced from alcohol. In addition the high efficiency of plant results in the saving of significant amounts of materials valuable elsewhere in the war effort.

The history of this project goes back to Pearl Harbor, when it became apparent that a complete breakdown of our war effort could be avoided only by the large scale production of synthetic rubber. In fact, production at the rate of 800,000 tons a year had to be developed before the stockpile of natural rubber was exhausted. As the Baruch report stated, "Of all critical and strategic materials, rubber is the one which presents the greatest threat to the safety of our Nation and the success of the Allied cause."

As the Port Arthur-Beaumont area in Texas has the greatest concentration of petroleum refining capacity, and since half of America's known gas reserves underlie the soil of Texas, it is natural that it should be called upon for a major contribution in the tremendous task of making this country independent of foreign sources of rubber. In this area are the refineries of five large oil companies known to every motorist as vigorous rivals: Atlantic, Gulf, Pure Oil, Socony-Vacuum (Magnolia), and Texas Company. Here, in these five companies was an unparalleled source of supply of raw materials in a location where natural gas made available the tremendous requirements of cheap fuel. Here also was the technical know-how, the engineering and management personnel, and a reservoir of experienced operators, craftsmen, and technicians so vital to the project. Under the leadership of Herbert Henderson, now chairman of the board of Neches, the five companies offered to pool their resources and to undertake the construction of a butadiene plant financed by the Defense Plant Corporation, and to operate it on a non-profit basis as agents of the Rubber Reserve Company. The services of The Lummus Company, a leading engineering and construction organization in the petroleum industry, were enlisted.

At this time, butadiene had been produced only on a small semi-commercial scale and the processes that had been used were incapable of expansion to meet this new demand. A committee of six technologists, drawn from the five oil companies and from Lummus, was appointed to develop the processing scheme, design the plant, and assist in putting it into operation. Two of the three major process steps were designed directly from the laboratory pilot-plant scale—a scale factor of about 80,000 to 1. There was no time for the larger scale experimentation, normal in the development of a new industry. An added difficulty was the necessity for conserving critical materials.

The chemical engineering calculations for the plant cover some 6000 pages. After this was completed more than 300,000 man hours of engineering and drafting had to be done by Lummus before the final plans were all in the hands of the field construction engineers. The erection of the plant required more than 6000 men. While the work was under way on the butadiene plant, the key unit of the Neches project, the Defense Plant Corporation erected two copolymerization plants on adjacent sites, for the production of synthetic rubber by combination of the butadiene with styrene. Also at this time each of the five companies expanded its facilities for making raw material for the butadiene plant and for increasing its output of aviation gasoline. The companies spent many millions of dollars in this new construction.

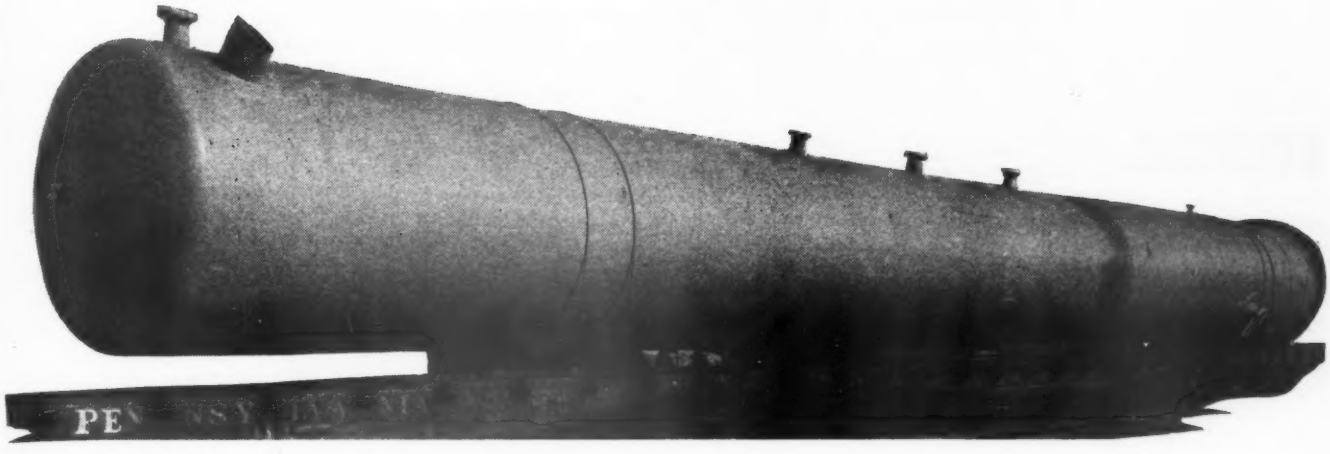
Upon completion of the first Neches unit, late in 1943, there was a complete crew of operators, maintenance mechanics, laboratory analysts, and management personnel ready to put it into operation. These men totaling more than 1000, had been drawn from the refineries and had already been trained to their tasks in the new plant. The Neches project, together with an identically designed plant for 50,000 tons per year at Sinclair Rubber in Houston, accounted for nearly one-quarter of the total government butadiene program and so the government agencies, the petroleum industry, rubber industry, and the armed forces were all following the progress of Neches Butane's first plant with interest and, frankly, anxiety. Much depended on its success.

After a short period of testing and running-in the complex equipment, the plant came into production in February, 1944, without any serious mechanical difficulties. Soon the soundness of the process was proved. It brought into operation a unique combination of new developments in the petroleum industry that increased the production of butadiene from a given amount of petroleum and, at the same time, recovered and purified essential raw materials for the making of 100 octane aviation gasoline. Important as the successful starting up of this plant was, there still remained a great many unanswered questions and potential problems that must be met by the operators—problems connected with the continuity of operation, mechanical maintenance, the severity of equipment corrosion when handling high temperature gases, corrosive acids, and enormous quantities of recirculated solvents—problems of control hitherto unknown in the art and requiring highly trained technicians using the latest analytical devices such as infrared spectrophotometry—problems of supply and coordination with the wartime production programs of the five refineries—problems involved in the dispatching and storage of vast quantities of liquefied gases. These problems had all been studied carefully by the designers and engineers but continued successful operation would depend in the last analysis on the highly trained operating staff and the team work of the management, technical, and operating staffs of the Atlantic, Gulf, Pure Oil, Socony, and Texas companies, cooperating with the Office of the Rubber Director and the Rubber Reserve Company.

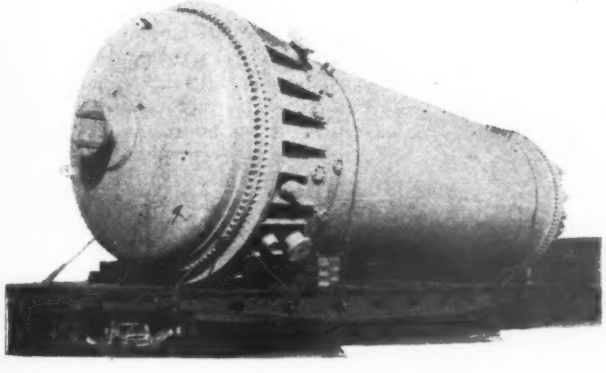
After a year's operation these questions have been answered. The plant has proved itself capable of producing butadiene of highest purity at a rate far in excess of its design capacity. The maintenance requirements are normal and the routine inspections and repairs can be done without extended periods of shutdown and without sacrifice in long time productivity. The yield of finished product per unit of recovered and purified raw material has averaged 71 per cent. In capacity operation the plant will produce butadiene at about 7 cents per lb.—cheap enough to yield synthetic rubber at an out-of-pocket cost of 10.7 cents per lb., as compared with the 1942 natural rubber price of 22.5 cents per lb.

Although built to meet a wartime emergency the Neches project is not a "war-baby"—it is here to stay. Utilizing readily available raw materials, it will be an economical peacetime producer of butadiene for synthetic rubber is cheaper than the natural product. This will assure the peacetime American motorist of a supply of good tires at a fair price and assure the United States of adequate rubber supply regardless of world conditions. ★★★

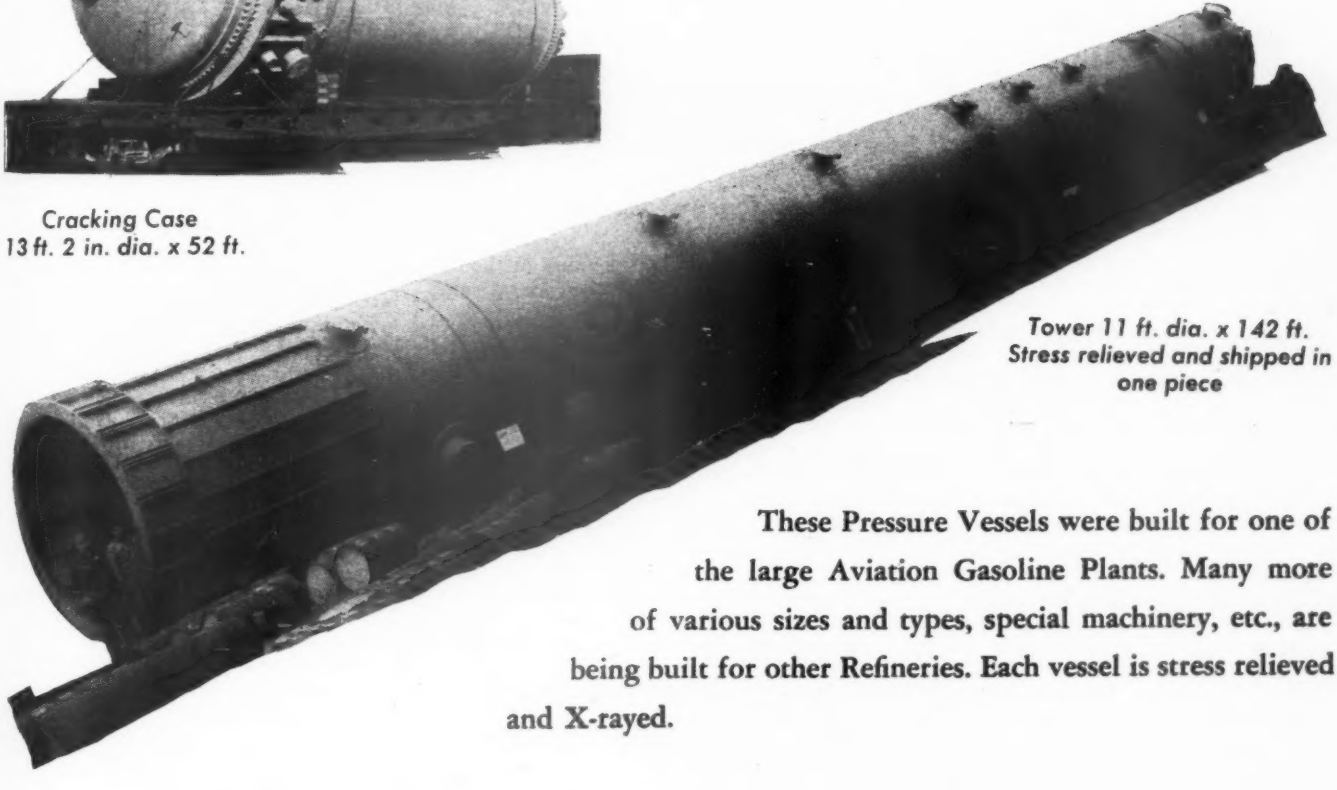
PRESSURE VESSELS



Fractionating Tower
9 ft. dia. x 105 ft.



Cracking Case
13 ft. 2 in. dia. x 52 ft.



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OIL WELL CLEANING

By **NORMAN C. WELLS,** *Production Engineer*
Signal Oil and Gas Company

EXCLUSIVE BEFORE discussing various types of well cleaning jobs and the methods best suited to each type of job, it is well to state that the most suitable method is usually the one that has given the best results under the same conditions, and especially in the same producing zone, as the well under consideration. This, however, is often difficult to ascertain without making several time-consuming and expensive trials on a number of wells in each field. It is hoped that this classification and discussion may be of some help to the operator in reducing the number of these trials and in making a logical selection of the best method that might apply to a certain well.

In classifying types of well cleaning jobs it is, of course, important to know something of the character of the material that is holding back production. The fact that production is being held back is, by comparison, easily determined. For example, even in high fluid level wells, the productivity index will take a distinct drop. Bailing will usually reveal the nature of the material to a limited extent. Pieces of scale knocked loose by the bailer or small chunks of tightly packed sand are quite revealing. In some cases, much can be learned from the bailing of neighboring operators. Inspection of a pulled liner is often helpful. Of particular interest is the bailer recovery in a well that has developed a hole in the pipe at some point in the perforated interval. This, for example, might reveal a scale formation back of the pipe with which the operator must contend. One such case will be helpful in determining the best procedure in a whole field.

Certainly, this is one phase of oil production where comparing notes with other operators will be conducive to higher ultimate recovery for all concerned.

To simplify the tabulation and discussion of methods of well cleaning, vertical slotted perforations and a reasonably straight hole will be assumed. Any deviation from these conditions will require obvious modification of the methods employed. Discussion, naturally, will be confined to the perforated section of the liner or oil string in the well. The best known methods, particularly mechanical washers, will be discussed the least because they are so well known to all operators. The term "mechanical washers" as used here refers to washers that utilize hydraulic action developed by mechanical means.

In making preparation for cleaning a well, consideration of the fluid to be present in the perforated interval is of primary importance. When water has to be added, it is usually best to use water from the well itself or from the same zone. Lacking this, sea water is used when it is convenient. Fresh water is very often deleterious to the well. It is best to avoid putting water of any kind into the well if possible. The same applies in a modified degree to putting oil into the well. The well's own production or production from the same zone is the best to use.

Referring to the tabulation, Classification of Well Cleaning Jobs, where alternate methods are listed opposite one condition, selection of cleaning methods is based upon some of the considerations in the following discussion.

Classification and discussion that aid in selection of the method most suitable for a specific well.

● **Mechanical washer.** Mechanical washing alone is wholly effective only in the easiest cases of well cleaning, such as loose mud or loose sand. It is of little use in paraffin or scale conditions, unless loose sand or loose mud results from a preliminary treatment, in which case it is effectively used as a followup. In conjunction with other methods it plays a very essential part. The term, as it is used here, includes hydraulic washers, etc. The various types are well known and are, therefore, not described in this discussion.

For well completions, mechanical washing is effectively used for washing oil base muds and organic colloid muds with oil. It is also used for washing conventional muds with salt water. In a well that has been producing for some time, however, the mechanical washer alone is seldom found to be the most satisfactory method of cleaning.

● **Acidizing.** Acidizing is the preferred method of cleaning up tightly packed conventional drilling mud. It should be controlled for minimum penetration into the formation, particularly in wells with tight sands, and the spent acid should be removed as soon as possible. Of course, in limestone or fractured shale, maximum penetration is desirable. If possible the work should be preceded by laboratory tests and should be undertaken by a reputable and experienced concern. The element of experience in all phases, including the technique of the operations involved at the well, is most important in the application of this method.

Acidizing is effective in removing scale. In most cases, however, the simplicity and effectiveness of string shooting is more desirable at least for the first attempt because it avoids possible damage to the formation.

● **String shooting.** String shooting effectively breaks up scale in the perforations and inside the pipe. The pieces can then be removed by bailing. Scale at the back of the pipe is fractured to provide passages for fluid.

So-called "sausage" shots are dangerous from the stand-point of damage to the pipe. Two strings, without sausage shots, are usually sufficient and will not damage a normal liner or oil string.

In some cases string shooting is effective in removing a tight mud cake. If the mud cake is already tightly packed, the initial pressure wave, a positive wave, has little or no additional compacting effect. The wave following this is a negative wave and tends to pull the mud cake away from the sand face and disintegrate it. The net result favors the pulling effect of the negative wave rather than the compacting effect of the positive wave. The well can then be treated under classification 1a.

● **Solvents.** In this category there are available a number of products ranging from kerosine distillate to various compositions. They are most effective in removing paraffin deposits from wall surfaces such as the inside surfaces of casing and tubing. When used with mechanical washing they may be effective through and beyond the perforated pipe depending upon the type of material that is combined with the paraffin. Where paraffin deposits occur inside the pipe to the extent of closing perforations and where they obstruct flow in the tubing, the mere introduction of solvent into the casing is often effective. This may be accomplished in either flowing or pumping wells without shutting them down.

Heating, of course, increases the effectiveness of the solvent. The temperature in the well heats the solvent to a certain extent.

● **Knife cleaner.** This method is particularly adapted to cleaning out clogged vertical slots in fairly straight holes. The knives reach back of the pipe about 1½ in., breaking up tightly packed material. The use of the tool is often sufficient in itself but is particularly suited as a preliminary step in cleaning with chemical, or mechanical washing, or both.

● **Wire brush.** This tool has been included in the classification table but it

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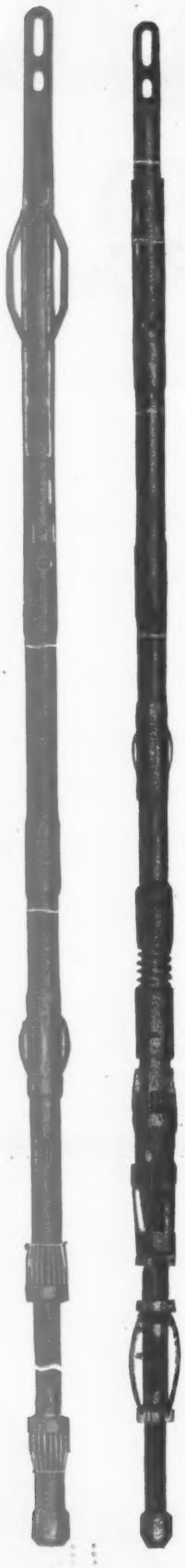

To loosen and remove material such as sand, shale, mud, etc., which is clogging the openings, and which has accumulated around the outside of various oil well strainers, use a CAVINS Perforation Washer or a Cavins Screen Cleaner. Either tool is a combination of the well known Cavins Automatic Hydraulic Suction Bailer and its respective attachments, and runs with the same type of equipment as is used with the Bailer. The energy of the fluid column is utilized, and action may be concentrated on any section of the liner or oil string to the exclusion of the rest of the section.

The CAVINS Perforation Washer

(Left-hand Illustration)

This tool is made up of the Cavins Automatic Hydraulic Suction Bailer and two attachments, the Up-Trip and the Pack-Off Mandrel. Because of the relatively large openings in perforated pipe, and the nature of the formations usually found where this type of well strainer is used, the tool combined the double function of opening perforations and thoroughly flushing the annual space behind the pipe, all in one operation. It opens all the perforations in the desired section. . . . After the well has been cleaned out with the Cavins Bailer, the Up-Trip is installed between the Jars and the Suction Chamber in the Bailer. The Pack-Off Mandrel is screwed into the bottom in place of the regular sand show. The Washer is then run in to the desired point. After the specified perforated section has been washed, the assembly is changed back to the Cavins Bailer to clean out all material which has been dislodged during washing operations. . . . For pipe sizes from 3½ in. O.D. to 8⅝ in. O.D.

The CAVINS Screen Cleaner

(Right-hand Illustration)

This tool is run in to a point just below the section of screen to be cleaned, then raised about 18 inches to unlatch the slips. Then, by lowering the tool, it is tripped "on Bottom" just like the bailer. The weight of the fluid column above the tool drops down against the fluid within the screen with a resilient HAMMER BLOW of FLUID against FLUID that drives back the sand grains that had arched or bridged the openings, and then draws the mud, shale, etc., into the well. This hydraulic fluid action is harmless to the screen, and insures a quick, simple, effective screen cleaning job at low cost. . . . For pipe sizes from 3½ in. O.D. to 9 in. O.D.

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is largely used in special cases. Its principal application is in cleaning all types of foreign material, including paraffin and scale, from inner surfaces of pipe and tubing. For cleaning vertical slotted perforations it is limited by a penetration of not over ¼ in. back of the pipe. However, for round perforations this is the best penetration that could be expected by mechanical means and the tool becomes very useful.

● **Caustic.** There are various types of caustic treatments available. One of them has recently been developed into a very practical well cleaning process in conjunction with the knife cleaner and mechanical washing. The whole operation is performed with a sand line.

The chemical is in crystal form and comes in sealed aluminum canisters. These are placed in steel tubes connected in series. Before being lowered into the well, holes are punched in the canisters.

The perforated interval to be cleaned is submerged with water. When the tubes are lowered into this water a violent reaction takes place and high temperatures are created. This action is enhanced by the presence of the aluminum that dissolves in the caustic solution, releasing gas. The tubes are slowly spudded up and down through the perforated interval for a period of approximately 2 hours, the length of time required to expend the caustic.

The chemical reaction with paraffin binder, aided by high temperature and agitation, loosens the solid material for removal from the hole by mechanical means. It should be borne in mind that the caustic solution will dissolve aluminum liners and packers, in fact it is often used to accomplish this. It will not damage steel or cement, however.

The complete procedure used for a thorough cleaning is as follows:

1. **Bail to bottom.**
2. **Open perforations with knife tool.**
3. **Bail.**
4. **Introduce water if necessary.**
5. **Run caustic tubes.**
6. **Bail.**
7. **Run knife tool.**
8. **Bail.**
9. **Wash with sand line suction washer.**
10. **Bail.**
11. **Put well on production.**

Excellent results have been obtained with this method where a difficult blocking material is encountered, particularly if a sticky paraffin binder is present with other material such as sand and mud. In extremely stubborn cases the steps following the caustic treatment might have to be repeated.

● **Conclusion.** When the work calls for mechanical washing, either alone or in conjunction with some other process, it should be done thoroughly. Neglecting this phase of the operation might result in loosened material clogging up the perforations. Patience in this and other aspects of the work is very essential. The results obtained should not be judged too soon. Observation of the production for several months before and after the job is done is of great importance. It is only by doing the job thoroughly and observing the results over a sufficiently long period of time that comparisons of value can be made.

Classification of well cleaning jobs

Condition	Methods of cleaning
1. Mud.	
a. Loose	Mechanical washer.*
b. Tight	Acidizing and mechanical washer.
	String shooting and mechanical washer.
2. Sand.	
a. Loose	Mechanical washer.
b. Tight	Knife cleaner and mechanical washer.
3. Paraffin.†	Solvent.
	Caustic.
	Wire brush.
4. Scale.	String shooting.
	Acidizing.
	Knife cleaning.
	Wire brush.
5. Mud, sand and paraffin gumbo.	Caustic, knife cleaner and mechanical washer.

*The term "mechanical washer" refers to all devices that develop a hydraulic action by mechanical means.
†The word "paraffin" is used rather loosely as referring to any wax or gummy substance associated with oil. ★★★

SALT WATER DISPOSAL IN EAST TEXAS

VOCATIONAL CLASS PROCEEDINGS

INSTALLMENT NO. 7

EXCLUSIVE ● **Stanolind Oil and Gas Company.** Early in 1939, this company converted an old oil well, R. A. Moores 3, J. B. Cadena Survey, Joiner area, Rusk County, into a salt water injection well by deepening the hole to 3727 ft. The 7-in. oil string had been cemented at 3626 ft. A 5-in. short string or liner was run and cemented between 3516 and 3678 ft. A string of 3-in. cement lined tubing was run with a sealed packer to a point two joints below the top of the 5-in. short string. Injection has been through the lined tubing and unlined 5-in. casing, but the exposed iron has given no apparent trouble.

Stanolind's salt water treating plant differs considerably from others in the field. The free water from various wells comes to a baffle type wooden gun barrel tank, and most of the water handled goes directly to the settling pit from this tank. Some emulsion (oil and water), however, is skimmed off this main receiving tank and taken to a treating tank. After passing through a heater and returning to the treating tank, water recovered from the emulsion is sent to the settling pit. All salt water enters the concrete settling pit through an elevated wooden aerating chamber, passes through the various compartments in the pit, and leaves by gravity flow to the filters. The concrete settling pit is 50 ft. square and construction details will be found in an accompanying drawing. (Fig. 51).

The two filters are radically different from those ordinarily used. Each filter is composed essentially of an 8-in. by 7-ft. section of pipe and a flannel sack or lining. The aerated salt water is strained through the flannel sacks and sent to the injection well under natural head. A light pump and a heavy power pump are available for injection purposes, but they are normally cut out of the line.

● **Tide Water Associated Oil Company.** Early in 1939 the Tide Water Associated Oil Company completed an elaborate aeration and treating plant on its Tom Bell lease, Kilgore area, for handling Woodbine water before injecting it into the water section of the producing formation. The company also drilled an injection well.

In building the treating plant, the company recognized the presence of certain undesirable dissolved substances or precipitates in Woodbine water. The Tide Water plan calls for aeration and treatment by chemicals before returning it to the base of the Woodbine. The principal substances recognized as clogging

FIG. 52. ELECTRICAL LOG AND WELL SKETCH
Stanolind Oil and Gas Company, R. A. Moores 3, Rusk County, East Texas field

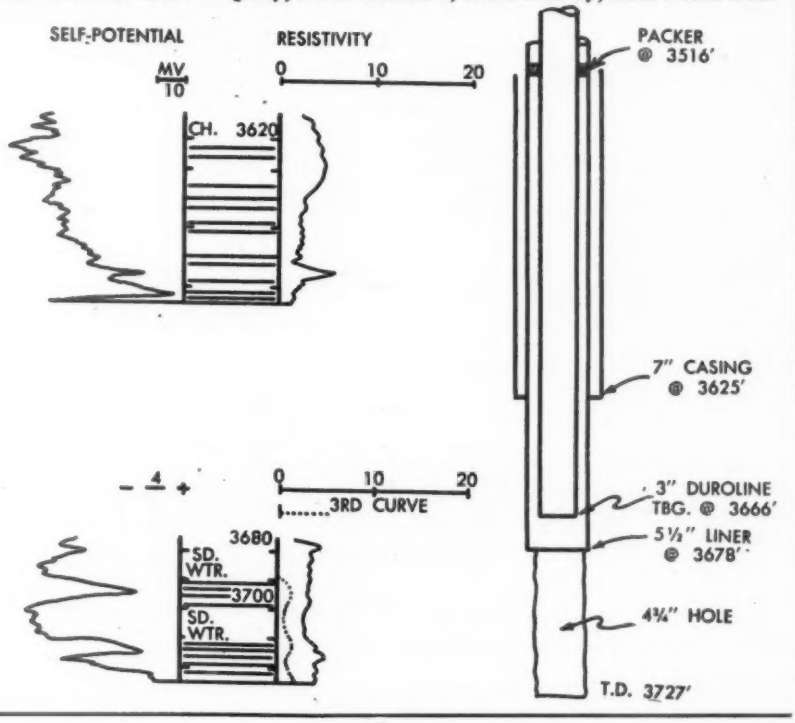


FIG. 53

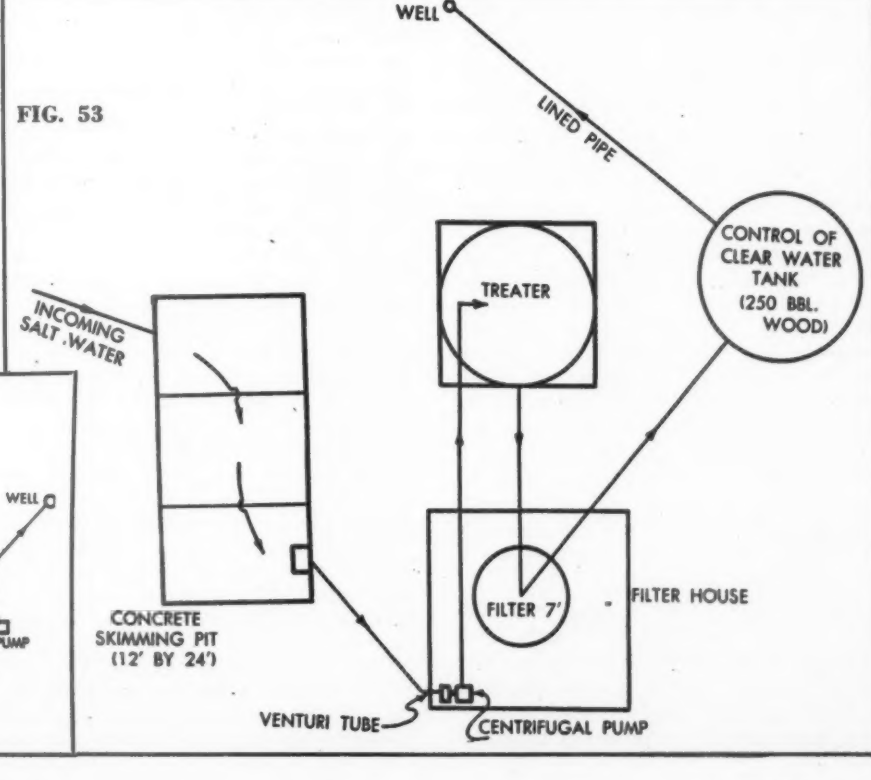


FIG. 51

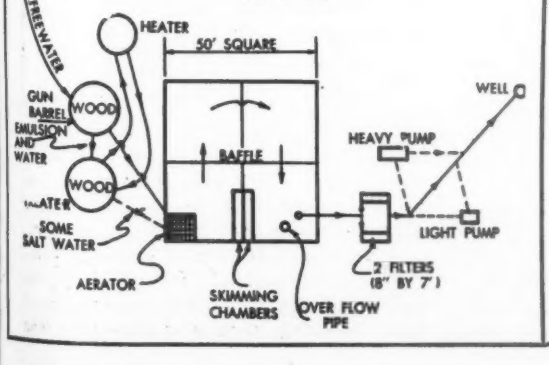
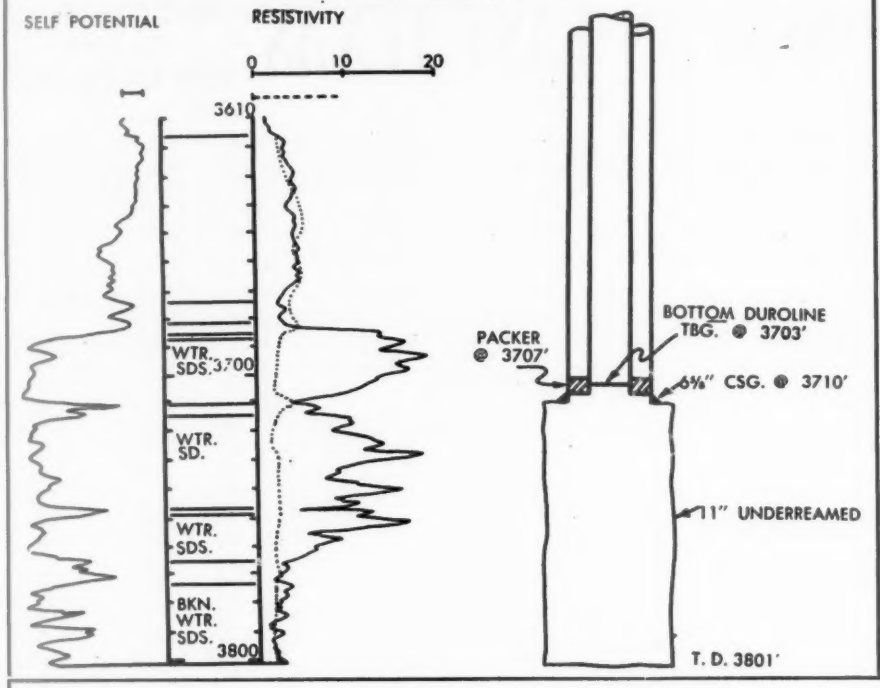


FIG. 54. ELECTRICAL LOG AND WELL SKETCH
Tide Water Associated Oil Company, Tom Bell 18, Gregg County, East Texas field

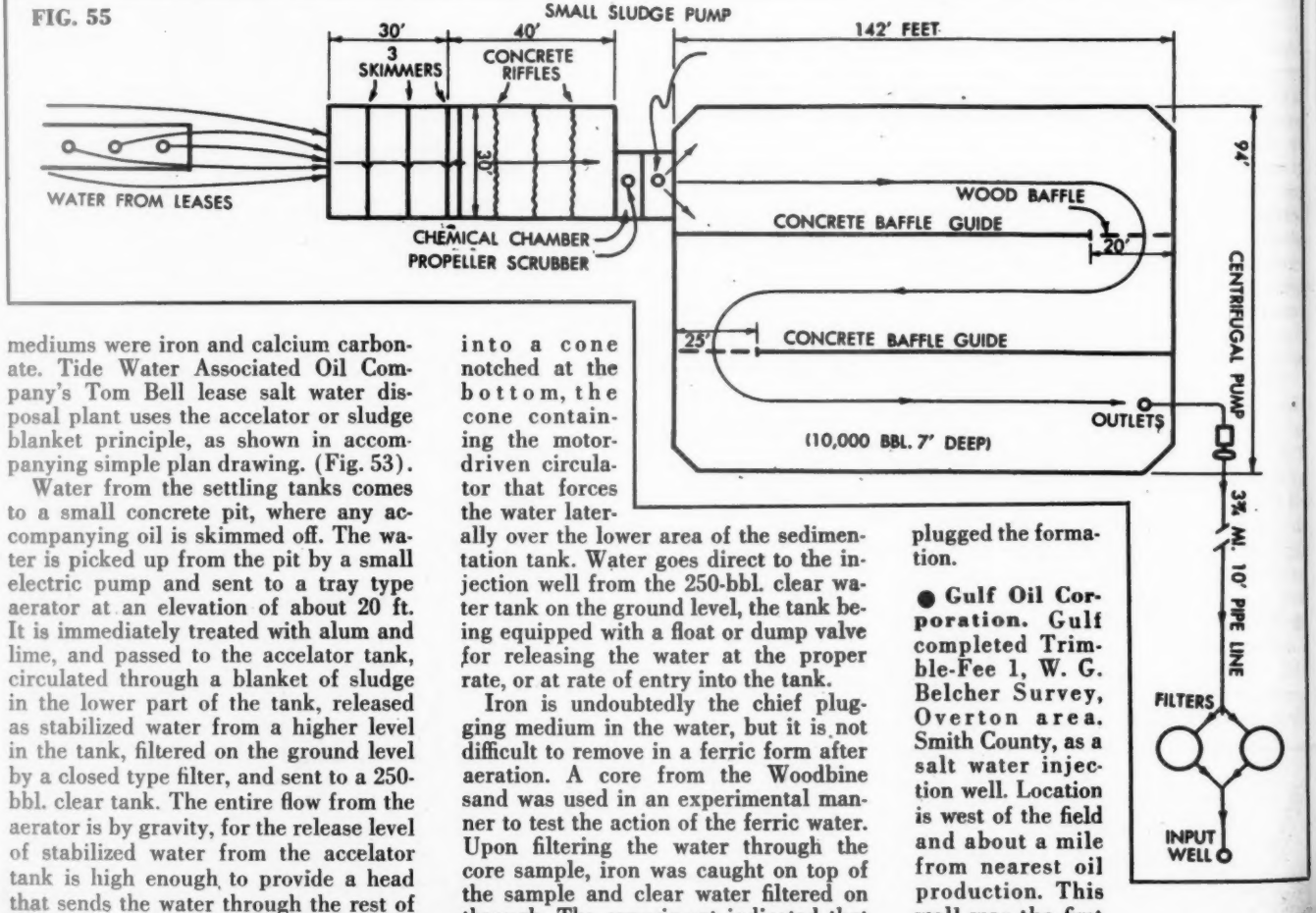


water. The well is located within the producing limits of the field, but near the west edge.

A 9¼-in. hole was drilled to the oil sand, and a 6¼ in. hole was cored to a level below the oil-water contact. The hole was then rat-holed ahead to 3800 ft., after which an electrical logging device was run as a positive check. The hole was then reamed to casing seat with 9¼-in. reamer, which placed bottom of the hole at about 40 ft. below the oil-water contact and below a shale break. A string of 6⅝-in. casing was run and cemented with 150 sacks. Reverse circulation was used for circulating all mud from the hole. Below the casing the hole was underreamed to 9⅞ in. with an expanding underreamer, salt water being used as a circulating medium. Final depth of the hole was 3800 ft. The large open hole below the casing shoe exposed a large area of sand.

Cement-lined tubing was run and packed off against the casing at a point near the casing shoe, leaving a negligible amount of iron exposed to the salt water during injection. Ordinary steel tubing was run and used originally, but the iron picked up from the tubing soon

FIG. 55



mediums were iron and calcium carbonate. Tide Water Associated Oil Company's Tom Bell lease salt water disposal plant uses the accelator or sludge blanket principle, as shown in accompanying simple plan drawing. (Fig. 53).

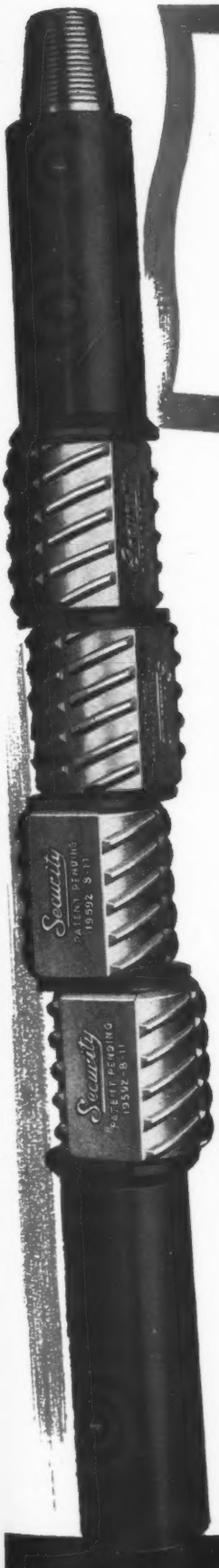
Water from the settling tanks comes to a small concrete pit, where any accompanying oil is skimmed off. The water is picked up from the pit by a small electric pump and sent to a tray type aerator at an elevation of about 20 ft. It is immediately treated with alum and lime, and passed to the accelator tank, circulated through a blanket of sludge in the lower part of the tank, released as stabilized water from a higher level in the tank, filtered on the ground level by a closed type filter, and sent to a 250-bbl. clear tank. The entire flow from the aerator is by gravity, for the release level of stabilized water from the accelator tank is high enough to provide a head that sends the water through the rest of the system and into the wellhead without additional pumping.

The incoming water passes from the discharge pan of the aerator to and through the air separation tube in the middle of the accelator tank, the entrained air and dissolved gases escaping in the gravity process. The tube fits into a cone notched at the bottom, the cone containing the motor-driven circulator that forces the water laterally over the lower area of the sedimentation tank. Water goes direct to the injection well from the 250-bbl. clear water tank on the ground level, the tank being equipped with a float or dump valve for releasing the water at the proper rate, or at rate of entry into the tank.

Iron is undoubtedly the chief plugging medium in the water, but it is not difficult to remove in a ferric form after aeration. A core from the Woodbine sand was used in an experimental manner to test the action of the ferric water. Upon filtering the water through the core sample, iron was caught on top of the sample and clear water filtered on through. The experiment indicated that iron, in plugging the sand in an injection well, chiefly sticks on the face of the sand and does not penetrate far into the formation.

The injection well, Tom Bell 18, F. G. Penn Survey, drilled by the company for use with the treating plant, was completed for one purpose—injection of salt plugged the formation.

● **Gulf Oil Corporation.** Gulf completed Trimble-Fee 1, W. G. Belcher Survey, Overton area. Smith County, as a salt water injection well. Location is west of the field and about a mile from nearest oil production. This well was the first in the field to use cement-lined casing, rather than lined tubing. An unusual feature of this 7-in. O. D. lined string was the use of 50 ft. of 7-in. non-corrosive alloy pipe to protect a porous sand that is not now needed for injection purposes, but may be needed at some future time. The 50-ft. section of alloy pipe was



Here's the tool that gives you real slicing action

THE *Security* CASING SCRAPER!

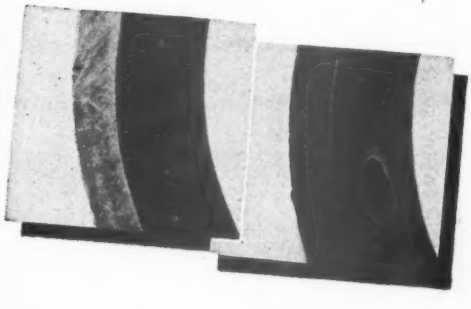
THE SECURITY Casing Scraper cleans out casing easier, faster and cheaper because it employs the same "angle of shear" that makes the Sievers Reamer so effective.

This shearing action makes this NEW Security tool especially effective for removing burrs left in the casing after gun perforating.

It *thoroughly* cleans out cement, scale, paraffin and mud from the inside walls of the casing and prepares it for the free passage of production tools and equipment.

The unique design of this tool offers many distinctive operating advantages. Four reversible cutters, slidably mounted on a square mandrel, are expanded firmly against the inside of the pipe by spring pressure. The multiple cutter teeth contacting the pipe, throughout their entire length, makes certain that every inch of the pipe gets a thorough cleaning. The reversible feature means longer wear, sharper teeth.

The shearing action of the cutter teeth allows the tool to work with minimum spring pressure, thus offering less chance of damage to the pipe.

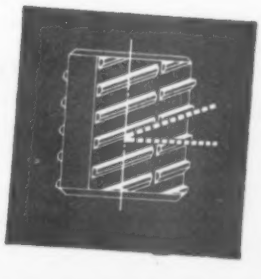


Actual unretouched photos of gun perforation in steel casing. Photo at left shows perforation with original burr on inside. Photo at right shows the same perforation after the Security Casing Scraper has been run. Note how the burr is cleanly removed, leaving the casing free for passage of tools and tubing.

IN CASING SCRAPERS AS IN REAMERS

Remember the basic cutting principle. There are three ways of removing material . . . scraping—crushing—shearing . . . and shearing is by far the most effective.

LOOK FOR THE ANGLE OF SHEAR →



SECURITY ENGINEERING CO., INC.

MAIN OFFICE & PLANT, WHITTIER, CALIFORNIA

Midcontinent, 1053 Mellie Esperson Bldg., Houston, Texas

Export, 420 Lexington Ave., New York City.

Dallas, Odessa, Tex.; Casper, Wyo.; Centralia, Ill.; Bakersfield, Ventura, Avenal, Coalinga, Calif.

placed in the string between 3881 and 3931 ft., and the 7-in. lined casing continued to 4000 ft. The well was drilled to 4191 ft., but the most porous sand section was between 4000 and 4050 ft. If it becomes necessary to inject water at an increased rate, or if the 4000-4050 ft. zone should prove an inadequate disposal medium, it will be an easy matter to ream out the 50-ft. section of 7-in. alloy casing between 3881 and 3931 ft. and inject salt water into this zone that is now protected.

Salt water from the various Gulf leases is brought to a large concrete settling and treating pit in a convenient part of the field. The main gathering line is a 12-in. composition conductor. The flow prior to injection is through 3 concrete skimming chambers, over a series of concrete riffles for aeration, through a propeller type scrubber that mixes alum with the water, through a small sludge chamber, and into the first compartment of the main concrete settling pit. The 94-ft. by 142-ft. settling pit is divided into 3 equal compartments, the flow of salt water being sent from one to the other by concrete baffles. The main pit is 7 ft. deep and has a capacity of 10,000 bbl. Full details of this flow are shown in Fig. 55. The small sludge pump in the chemical chamber is used to transfer the alum sludge from the second to the first compartment, thus preventing the surplus from entering the main settling pit.

The aerated and settled water is picked up by a centrifugal pump and sent 3¾ miles through a 10-in. composition pipe to the filters and injection well located about one mile outside the field. Although the injection well takes water readily under natural hydrostatic head, the pipe line leading from the settling pit to the wellhead attains an elevation at one point of about 50 ft. above the pit. During normal injection operations, the maximum line pressure is about 100 lb. The greatest pressure obviously is at a point just beyond the pump at the pit, due to the fact that the well pulls a vacuum on the filters and that portion of the line near the well.

An innovation in filter piping has been developed by Gulf engineers to prevent disturbance of the sand face in the filters. As the well pulls an appreciable vacuum on the filters, air lines are provided to equalize the air pressure between the top of the filters and the main fluid line leading from the filters to the injection well. This is accomplished by use of 2-in. by 30-ft. pipe risers from the top of the filters, these risers opening into a common 2-in. drop into the injection line. As the well continues to take water by vacuum after the pump at the pit is stopped, the suction action might ordinarily disturb the sand in the top of the filters. Use of the air riser lines equalizes the air on both sides of the filters. During rapid injection operations the risers are partly filled with water from the top of the filters, but a considerable pressure is required to force the water over the top and down the drop line.

● **The Texas Company.** This company's Kersh 5, E. B. Foulkes Survey, Joiner area, Rusk County, originally an oil producer in the Woodbine sand, was deepened to 3792 ft. in water strata. The well carried a 7-in. oil string at 3570 ft. A 5-in. short string was run and cemented between 3450 and 3636 ft., and a string of 3½-in. cement-lined tubing run to the top of the short string. This lined tubing would not pass through the 5-in. string, and injection has been through lined tubing and unlined short string.

Three 1750-bbl. wooden settling tanks and a sand filter are the principal items used for preparing the salt water for injection. The water comes to the wooden settling tanks through flumes from steel gun barrel tanks nearby. The three 1750-bbl. tanks are tied together, through the medium of a common outlet pipe to the filter, the water level being fairly equal in all tanks. The water drops down into each tank through holes in the flume. The flow of water in each tank is through a wooden conduit to a level near the tank bottom, then around baffles to the outlet. The outlet pipes are about 6 ft. from the tank bottom. The filter is a few feet below ground level to encourage a natural flow between settling tanks and well. A sand type filter is used. An elevated wooden backwash tank supplies fresh water for cleaning the filter. (Fig. 56).

★★★

(To be continued in an early issue)

FIG. 56

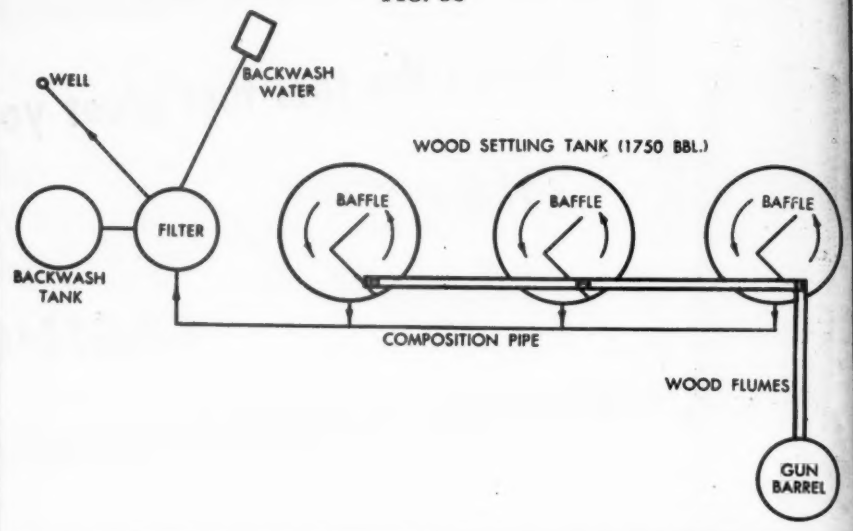
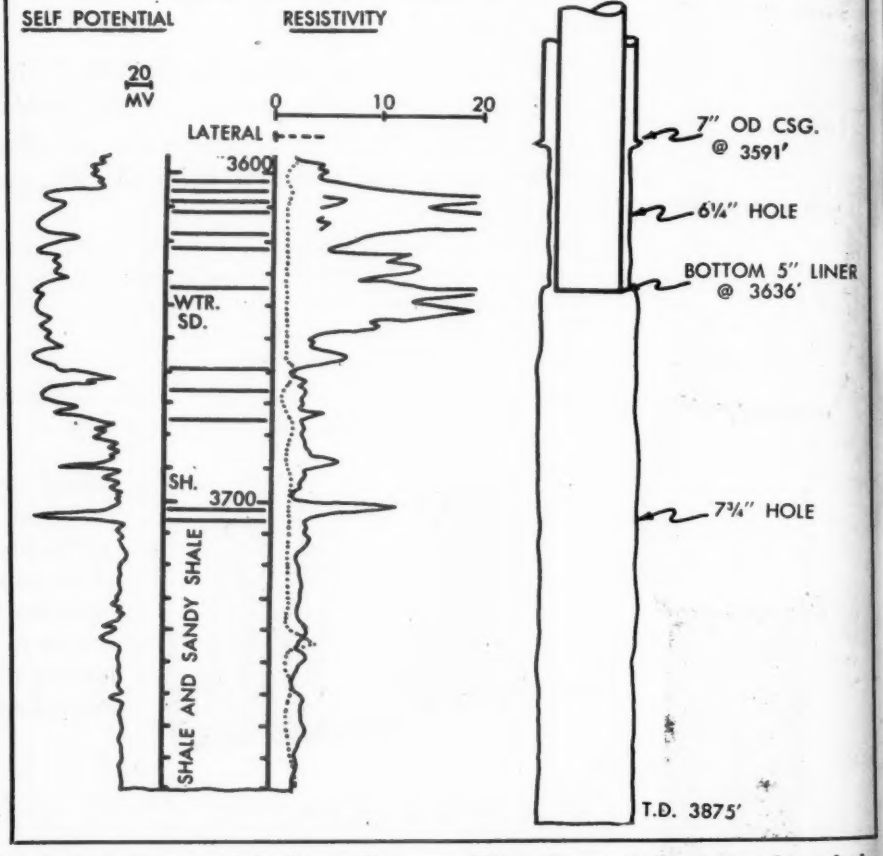


FIG. 57. ELECTRICAL LOG AND WELL SKETCH
The Texas Company A. W. Kersh 5, Rusk County



Baash-Ross News

BAASH-ROSS TOOL COMPANY · LOS ANGELES · HOUSTON · NEW YORK

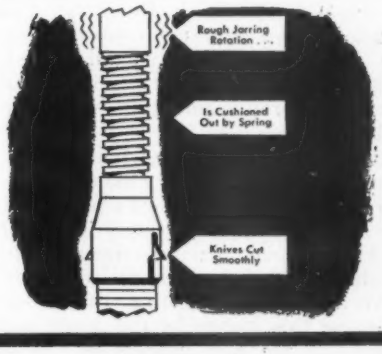
OUR 25th YEAR

These 3 Advantages are what give the BAASH-ROSS INTERNAL CUTTER that extra margin of Safety and Efficiency

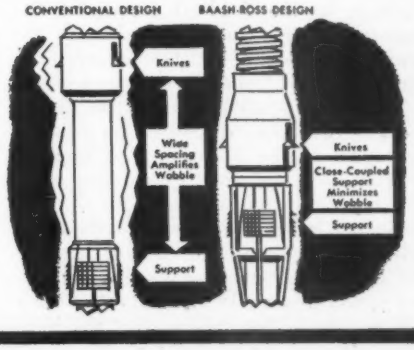
VIRTUALLY all pipe cutters work on the same basic principle—that of expanding knives against the surface of the pipe to be cut and then rotating these knives until the cut is completed. But the engineering refinements in this basic principle are what make the vital difference in pipe cutters, for such apparently small details as where the cutter support is located in relation to the knives and how the cutting force is applied can make a very substantial difference in the over-all operation and efficiency of the cutting tool.

For example, note these advantages engineered into the BAASH-ROSS INTERNAL PIPE CUTTER—and the reasons why they permit smoother, faster cuts and more economical cutting . . .

SMOOTH CUSHIONED FEED! In the *Baash-Ross Cutter*, weight is applied to the knives *through* this coil spring which cushions out the vibration and irregular feed of the rotating drill string. This is a great advancement over the conventional arrangement of applying the bare weight directly to the knives. It also eliminates need for any complicated accessory equipment to control weight. Baash-Ross cushioned feed means smoother, cleaner cuts and greatly minimizes breakage of knives even under rough handling!



RIGID NON-WOBBLE SUPPORT! Here's another important reason for the unusually fast clean cuts you get from a *Baash-Ross Internal Cutter*. Ever notice how a lathe tool cuts smoother when working close to the support? The Baash-Ross Cutter is engineered on this same principle, for the support slips are positioned unusually close to the knives. This practically eliminates all wobble, chatter and knife breakage, giving a much smoother, faster cut than possible where knives and support slips are widely separated as in conventional design.



MULTIPLE CUTS PER RUN! And here's a vital Baash-Ross feature that means both speedier and more economical cuts. With the Baash-Ross Internal Cutter you can make successive cuts on *one* trip without removing the tool for resetting. This feature is particularly valuable when you are not sure where the pipe is stuck. Simply start at either the top or bottom and make successive cuts as desired. Cut sections can later be recovered with a spear or socket. Saves time, simplifies operations, cuts costs!

CUTS TUBING, DRILL PIPE, LINERS, CASING!

No matter what your inside cutting job, there's a size and type Baash-Ross Internal Cutter to handle it. Even a type for Internal Upset pipe. Your nearby Baash-Ross representative will be glad to give full details or write direct. Also see pages 290-291 of your Composite Catalog!

LABORATORY TO STUDY JET-PROPULSION FUELS

A LABORATORY for the study of fuels and lubricants for jet-propulsion aircraft has been built and put into operation at Wood River, Illinois, officials of the Shell Oil Company announced. The laboratory, a complete, full-scale installation, was designed to study the action that fuels undergo in jet-combustion.

A jet burner, whose size and construction remain a military secret, has been installed; fuel is furnished by ten 5,000-gallon tanks; and compressed air, necessary for jet-combustion, is supplied by a 1000-hp. compressor, so large that it would require a 6-room, 2-story family dwelling with ceilings and walls knocked out, to house it. Something new in combustion, the jet burner produces in a much smaller amount of space about 250 times the heat of a residential oil burner and creates a stream of hot gas of greater than hurricane velocity.

Combustion of such a radically new character requires new basic research, and completely new studies of burning characteristics of possible fuels have been undertaken. By means of elaborate electrical recording devices located in a heavily soundproofed control room, the new laboratory is compiling performance records on fuels suitable for use in jet-propulsion and combustion turbine engines.

In addition to surveying fuel requirements, and determining characteristics and qualities of fuels most efficient for jet-combustion, the laboratory is also at work developing new experimental apparatus for further use in this research.

At a technical meeting called for sometime this month by the Army Air Forces at the new laboratory, latest findings in the field of jet-propulsion and combustion turbine fuels will be discussed by technologists from other oil companies and from the Army and Navy.

The combustion turbine (also called the gas turbine), an important component part of the jet-propulsion engine, appears to have great possibility as a new type of prime mover, which, Shell engineers believe, may eventually compete favorably with the steam turbine and diesel engine in locomotives, ships, and power houses. In aircraft other than military craft they believe that the best application of jet-propulsion will be in combination with a combustion turbine-driven propeller. Dream of engine de-

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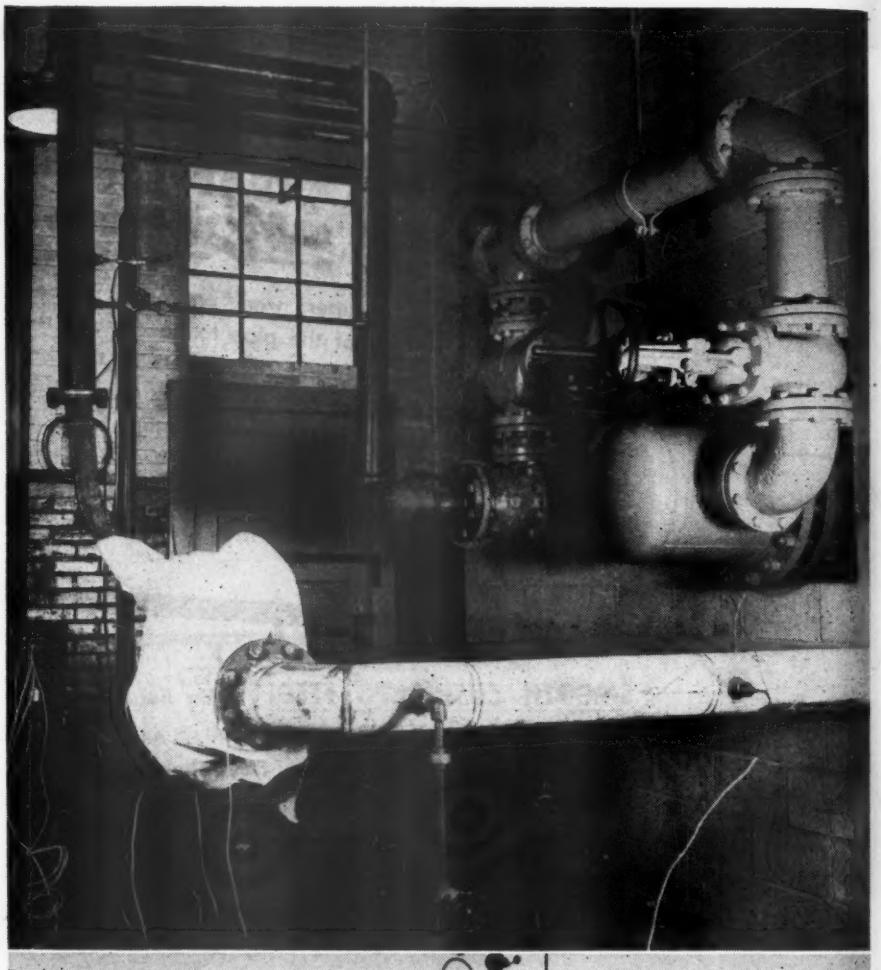
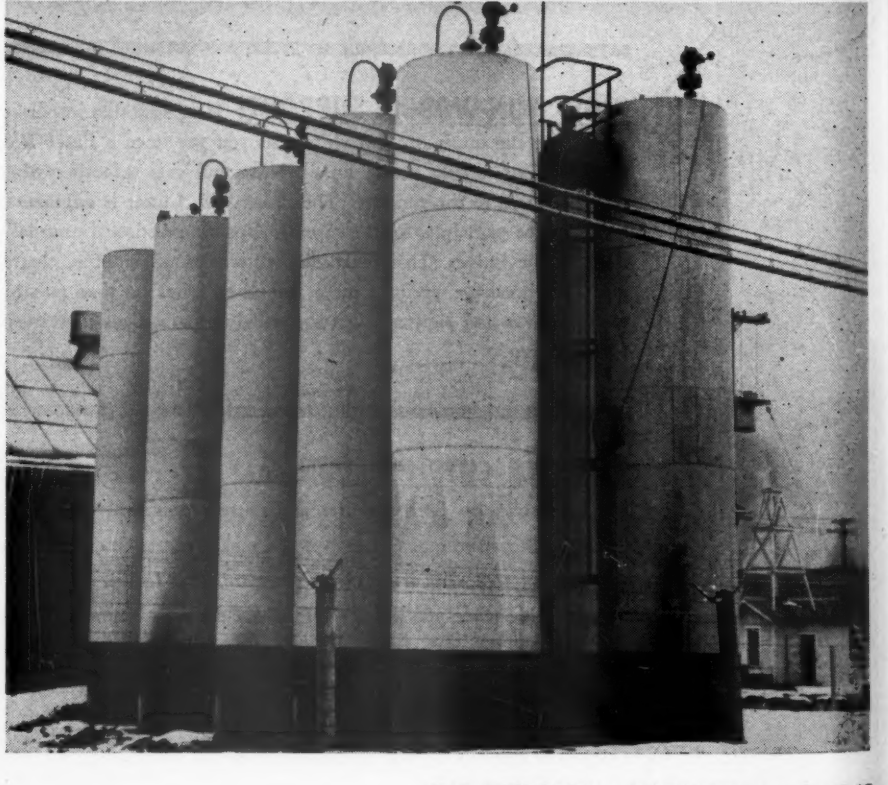




***Above*—The unit draped in canvas is the jet burner with which experiments on fuels are now being conducted by Shell. Because of secrecy still surrounding it, the burner itself cannot be photographed. *Below*—Ten 5000-gallon tanks store the fuel used for burning and for reference in experiments.**

DESPITE *given crude sources* and *established markets*... refinery managements and their engineering staffs do not have a simple task in reaching decisions on postwar remodernization plans.

After due study of process recommendations and proposed capital investments . . . ticklish questions remain to plague. Is the plan sufficiently elastic to provide for envisioned product improvements? Does it provide the shortest pay-off period? Will current equipment be utilized to the fullest advantage?

It is here that the full scope of M. W. Kellogg's complete service is most appreciated—and valued—by customers. For this service embraces more than that of designer-builder. It shoulders the direct responsibility to the refiner of translating plant operations into maximum profits.

Supplementing and integrating the customer's management and engineering staff planning... Kellogg brings the full weight of its process design, pilot plant data, diversified outside commercial experience, and economic consultation services to bear on the specific problem involved.

Invariably, with increased profits as the goal, not one but several solutions present themselves. But for *maximum* profits . . . there is only *one!* For instance, in a recent case study, exhaustive analysis disclosed three different potentially profitable solutions.

Case A showed a 205% increase over existing yearly net credit... with a pay-out period for remodernization of 3.84 years—amortizing capital investment exclusively from the *increase* in annual credit.

Case B, on the other hand, showed an increase in yearly net credit of 263% (a further increase of 58%). In addition, it provided a shorter pay-out period—3.39 years—notwithstanding a 13% greater increase in capital expenditure.

Case C offered the same fundamental advantages as B . . . with a different choice of by-products.

Such detailed explorations of a client's problems demonstrate the responsibilities that M. W. Kellogg assumes over and above those of mere designer-builder. May we consult with you on your current plans?

THE M. W. KELLOGG COMPANY

Engineers and Economists to the Petroleum Refining Industry

★Only Kellogg Service Has Them All

★**LABORATORIES**—fully equipped and staffed—devoted exclusively to chemical engineering and process development.

★**24-HOUR-A-DAY PILOT PLANTS**—17 refining processes operating continuously—providing accurate data for commercial scale application.

★**EXCLUSIVE CHEMICAL ENGINEERING DATA**—Continuously compiled . . . embracing both pilot plant runs and the operation of Kellogg-built refineries. Data extends from beginning of modern refining.

★**PROCESS ENGINEERS**—Specialists who have continuously made major contributions to oil refining development, for more than 20 years . . . currently exemplified by their work on fluid catalytic-cracking.

★**MECHANICAL ENGINEERS**—Kellogg installations—worth hundreds of millions—are their best references.

★**METALLURGICAL LABORATORY**—Establishes continuous check of specifications...creates new techniques for the fabrication of refining equipment.

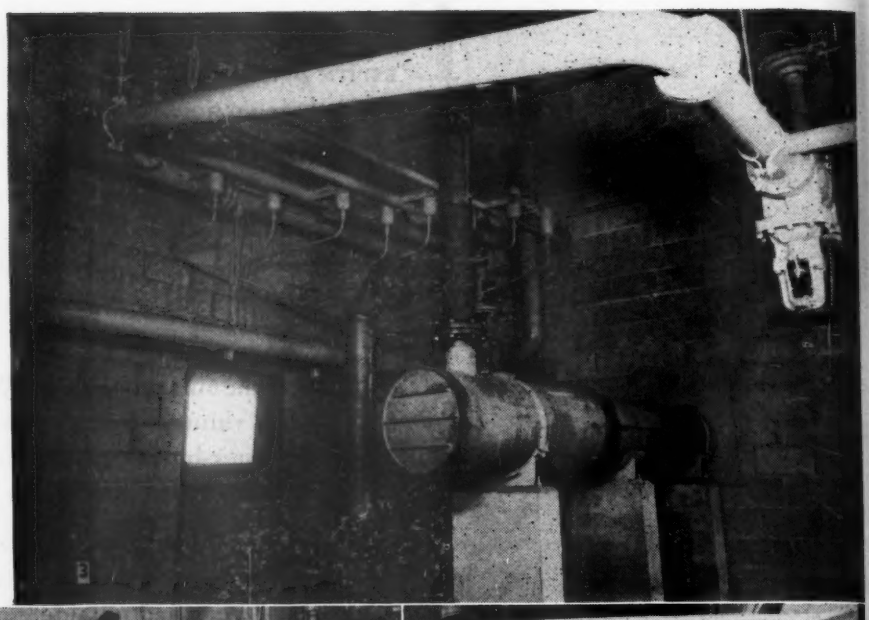
★**PERMANENT CONSTRUCTION CREWS**—Geared to function all over the world on single units or multiphase refineries . . . team-experience cuts costs, speeds construction.

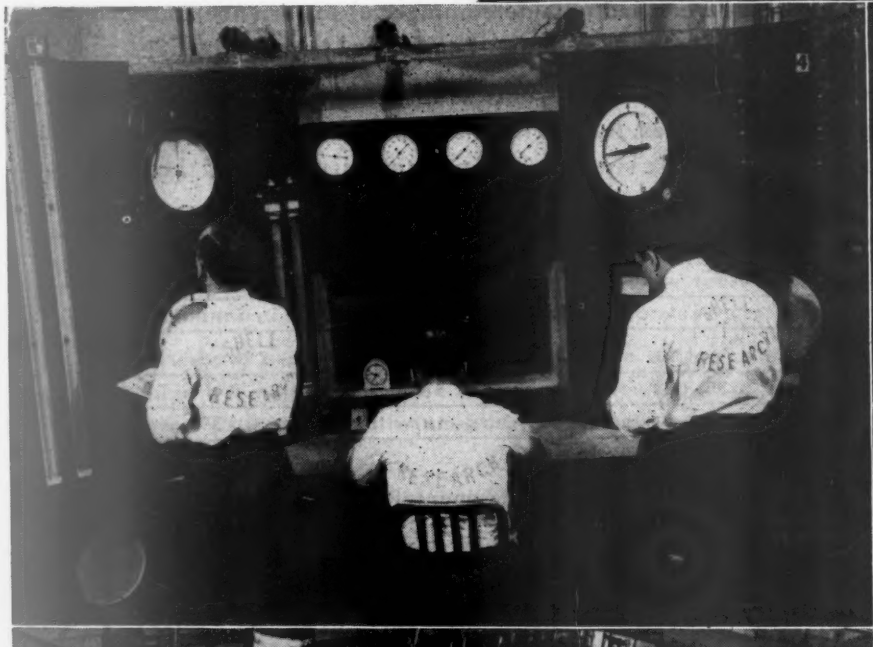
★**OPERATING STAFFS**—Specialists at placing new units "on stream"... training of refiner's own operating crews.

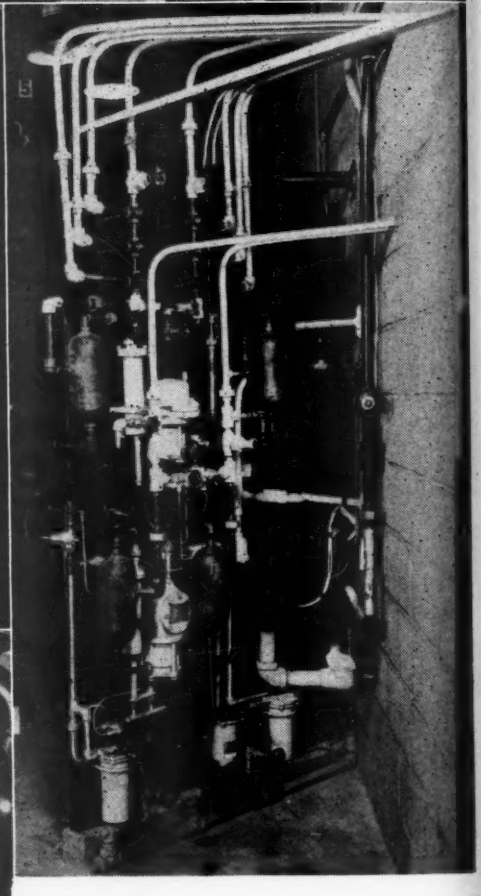
★**LICENSING SERVICE**—Licenses available through Kellogg as Licensor or licensing agent for all types of refining processes.

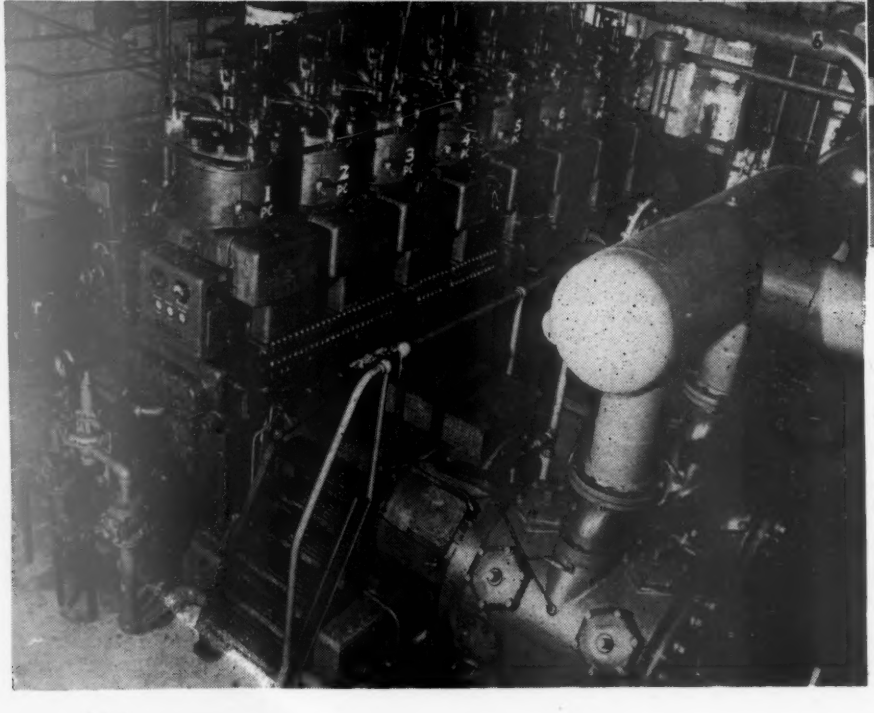
★**ECONOMICS CONSULTATION**—Offers oil companies the opportunity to have their overall operations reviewed and evaluated by personnel with authoritative and extended experience in the field of petroleum economics and management.

3. The stainless steel unit supported by the three cement blocks utilizes heat of jet-burner exhaust to heat compressed air being supplied to it.
4. The control board, in a heavily insulated and soundproofed control room, is responsible for recording experimental data, as well as automatically operating jet-burner in the new jet-propulsion laboratory. Engineer at center sits in front of observation window through which he can watch burning in operation.
5. Backing up the control board is an elaborate maze of gages and automatic regulators. Seen here are controls for one wing of the instrument panel.
6. Part of the huge compressor installation that supplies compressed air used by the jet-burner. Compressors are powered by combustion of refinery gases in power chambers labeled 1—8 PC.









(Continued from Page 108)

signers for over a generation, the combustion turbine has only recently become a reality through developments in metallurgy that made possible turbine blades able to withstand extremely high temperatures, and centrifugal air compressors efficient enough to be used with the new combustion turbine.

"The new laboratory at Wood River," said J. F. M. Taylor, Shell's vice president in charge of manufacturing, New York, "is an addition to the present fuel and product performance laboratories that were started there in 1927 and have grown rapidly ever since." ★★★

BREATHERS FOR BULK AND REFINERY STORAGE

Shown below is Model ST-3695B, an effective, moderately priced breather designed specifically to meet the venting requirements of bulk storage tanks. Available in 2, 3, and 4 inch sizes.

Above is Model ST-949 Weatherproof Breather, designed for the conventional types of refinery storage tanks. It is hooded against all weather conditions and screened against insects and windblown particles. Available in 4", 6", 8", 10" and 12" sizes.

SHAND & JURS has long been "headquarters" for the venting of all types of petroleum storage tanks, and manufactures a wide range of models and sizes to accommodate an equally wide range of pressures, capacities and weather conditions.

Shown here are two models which are widely used by bulk storage plants and conventional low pressure refinery storage. We also make pressure and vacuum regulators and relief valves for all types and shapes of high pressure tanks, so if you contemplate the installation of bullets, spheres or spheroids, consult us on your venting requirements.

SHAND & JURS CO.

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SHAND & JURS

ANALYSIS CRANKCASE OIL IN GAS ENGINES

By **ROY BLODGETT,** *Production Superintendent,* Long Beach Oil Development Company
and **DONALD M. NELSON,** *Field Engineer,* Faber Laboratories

EXCLUSIVE EFFICIENT and economic performance is the concern of everyone connected with gas engine operation. Gas engines must always be maintained, but any measures that will reduce major repairs or overhaul jobs and prolong the life of the engine are factors in economy. Efficiency of operation is in itself a cost item and its loss is frequently an indication of trouble. Preventive maintenance aims at the location of trouble and its immediate correction. It has been found that the condition of the lubricating oil and its content of foreign matter is indicative of a great many troubles and that by analyzing samples taken from the crankcase and circulating stream, remedial measures can be determined if the proper interpretation is made of the information obtained. An oil analysis and interpretation on service* has been employed for many years in maintaining automotive fleets. During the past year after the service had been pioneered in the field of natural gas engine operation as a joint effort of Long Beach Oil Development Company and Faber Laboratories a number of other oil companies have applied this service to oil field operations and plants where a sufficient number of gas engines is in use make it advantageous.

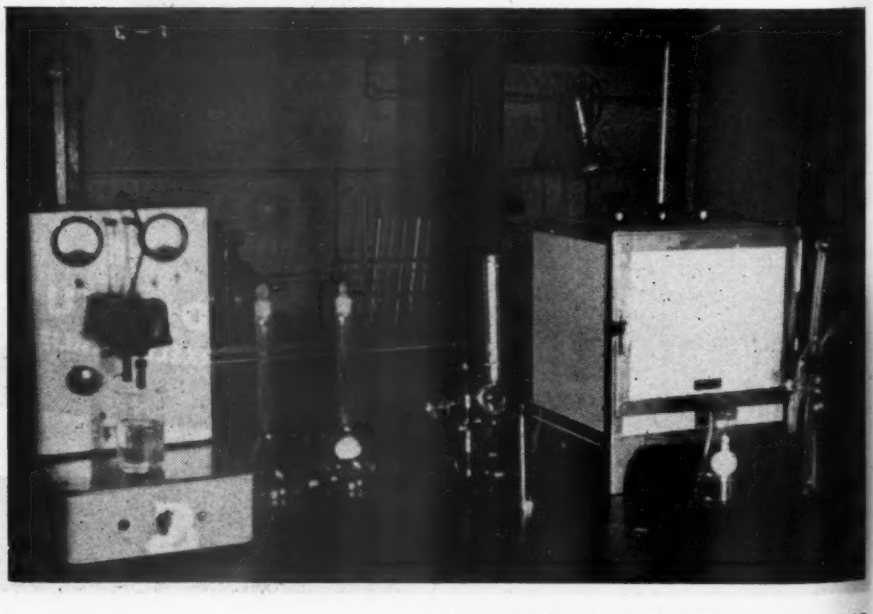
Any engine maintenance system requires that every available source of information relating to engine operation be used to diagnose and remedy controllable operating faults. The complete maintenance history, oil consumption records, the manufacturer's recommendations and the observations of the engine operator should all be utilized. The system of gas engine control by crankcase oil analysis discloses unsuspected operating faults and provides information that can be used to correct these faults before they cause serious trouble. Further, when oil is changed without correcting the reason for a poor condition, the same poor condition may be expected immediately thereafter the same as though the oil had not been changed at all. The procedure followed in the oil and gas industry is for the operating personnel to take samples at periodic intervals and send these samples to the laboratory for analysis and interpretation. A report is then supplied the operator with recommendations for the corrective measures necessary.

Those in charge of gas engine operation thus have readily available information relative to the maintenance practices in effect. Several producing companies in California have tests made every 60 days except when improper conditions are disclosed. The tests are then made at 30-day intervals until conditions are improved. In taking the 3½ oz. samples used for analysis a special long-stemmed sampling thief is used. This takes the oil from the bottom of the crankcase where most of the contamination is found. Then, because it is important to know what the circulating oil is like, a small hole is provided in the side of the stem a short distance from the open end to procure a portion of this oil also.

The report form, with some typical examples, is shown in Fig. 1. Percentage expressions of abstract technical determinations have been largely eliminated and substituted for these are degrees of oil contamination and deterioration based on established norms developed from thousands of such analyses. Considering the items in the order shown, "sludge index" is a new test developed during the course of an extensive wartime testing program to meet the needs of that program. By its use an accurate quantitative evaluation of oil deterioriation is made and its relationship to the "solids volume" test determines whether the detergent or dispersive characteristics of the oil remain, either as natural or additive detergency. Sludge index is based on a volumetric measurement of the initial oxidation and polymerization products formed as colloidal particles, which, until recently, had escaped detection because of their extremely small particle size and a density not much greater than that of the surrounding oil. By coagulating these particles with an aniline solution containing a small percentage of water, the coagulated particles are then of sufficient size and density to precipitate when centrifuged in a high speed centrifuge.

The material precipitated in a centrifuge tube by the "solids volume" determination is similar in composition and origin to that material determined by the sludge index test. "Solids" as shown on the report are formed, however, when the dispersive characteristics of the oil are insufficient to prevent the natural coagulation or "snow-balling" of the very finely divided initial breakdown products of the oil. When this dispersion and detergency is lacking it is a natural set-up for sludges to begin depositing. Very good correlation to actual engine conditions has been noted in instances where badly sludged engines have been predicted from oil samples showing high solids and equally high or higher sludge index. Equally good correlation has been experienced in predicting clean engines from consistently low solids and sludge index.

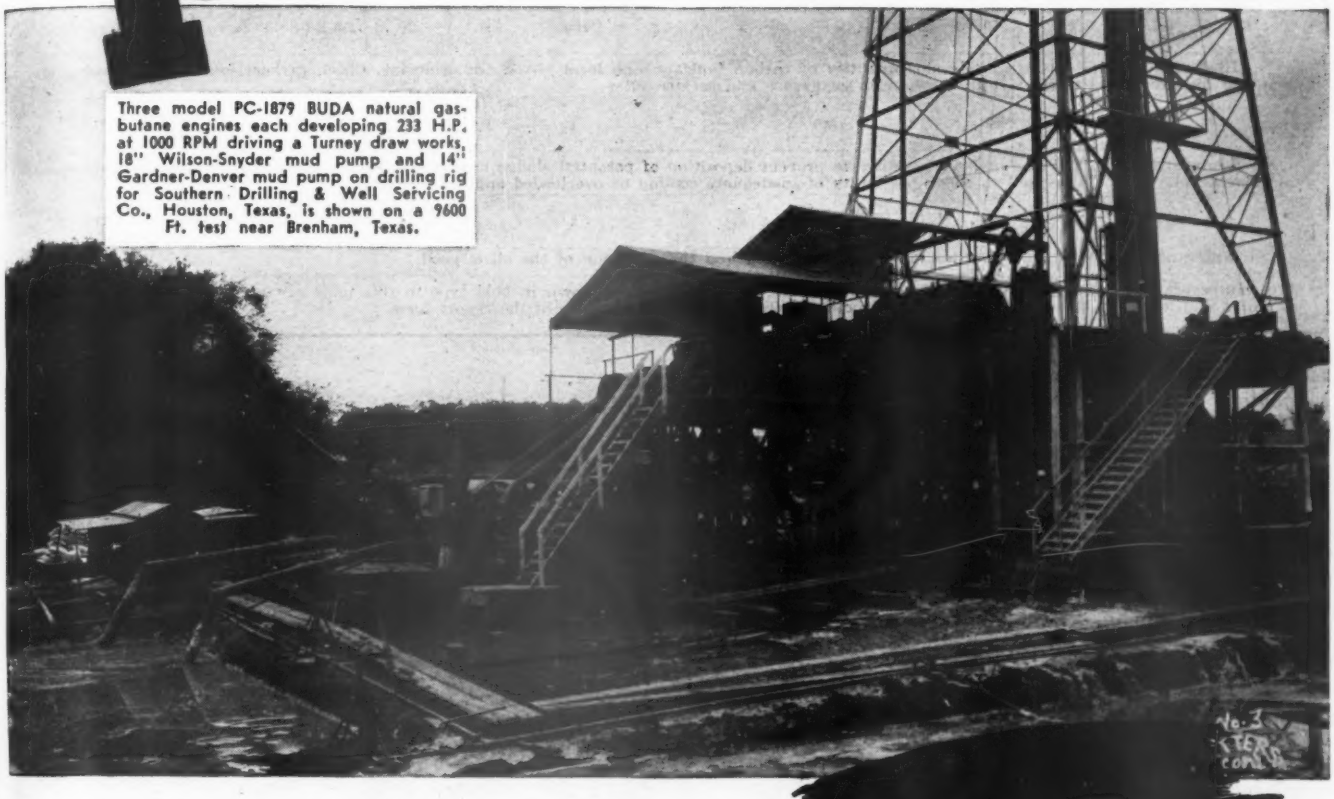
"Faber viscosity" is a specialized viscosity determination adaptable to mass production techniques with accuracy and with good correlation to operating viscosities. As the standard viscosity test



Section of special laboratory with some of the equipment used for metal and abrasives inspections.

*This service was developed and is provided by Faber Laboratories with laboratories in New York, Chicago, San Francisco, Seattle, and Los Angeles. Service to oil production equipment has to date been provided from Los Angeles.

power for drilling



Three model PC-1879 BUDA natural gas-butane engines each developing 233 H.P. at 1000 RPM driving a Turney draw works, 18" Wilson-Snyder mud pump and 14" Gardner-Denver mud pump on drilling rig for Southern Drilling & Well Servicing Co., Houston, Texas, is shown on a 9600 Ft. test near Brenham, Texas.

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FIG. 1—Typical reports for natural gas engines.

Engine number	Engine sludge index	Solids volume	Faber viscosity	Foreign matter: Metal	Water	Gums, tars, residues	Fuel soot	Free carbon	Dirt, sand	Analysis: Operating S.A.E. number	See reverse side†	Period this oil ran	Period next set	Test again	Oil add.
1	*4.0	*4.0	296	*Bearing	*Water 3.6 Emul.	x	x	x	x	Hy. 30	D-F-S 2-3-4-B	30 days	Drain now	4/21	
A considerable quantity of water and emulsion is noted and a check should be made to determine whether this is from condensation due to low general or localized temperatures or a leak. Extreme bearing wear is in evidence and motor should be held under close observation. Drain now and thoroughly flush crankcase, service filter.															
2	*5.0	0.2	256	Slight	x	x	x	*High	x	30	2-3-E-I-S	30 days	Drain now	4/21	
High sludge index and a considerable quantity of carbon indicate high local piston temperatures. Check carburetion, timing, cooling system and for overloaded engine. Drain now, flush crankcase and service filter.															
3	*3.6	0.3	*464	x	x	x	x	x	x	*50	2-3-C-S	60 days	Drain now	4/21	
Drain and flush crankcase and service filter to prevent deposition of potential sludge now in circulation. Severe operating temperatures are in evidence and it would be well to check possibility of inadequate cooling or overloaded engine.															
4	0.2	0.2	224	x	x	x	x	x	x	30		30 days	60 days	5/21	
Water reported at time of last test has been eliminated and the condition of the oil is good.															

*On the report form as kept by the service organization figures and numbers shown in bold type in this table are recorded in red.
†Figures and letters in this column refer to instructions printed on the reverse side of the report form.

methods require that the suspended contamination be removed before the viscosity is determined there is frequently a discrepancy between the actual operating viscosity of the oil in the engine and the test results obtained by these methods. The viscosity here used does not require the removal of suspended matter and is converted to operating SAE numbers on the report in order that a convenient comparison to the original viscosity might be provided.

The general classification, "foreign matter," includes all contaminants that might ordinarily be found in crankcase oil. They are graded not only qualitatively but quantitatively according to a simple but adequate quantitative scheme. Any contaminant reported in red ink *(shown in bold face type in Fig. 1)*, is present in an abnormal amount; anything reported as "slight" is borderline below abnormal; that which is reported as "trace" is borderline above normal. and that not present at all or not present in sufficient quantity is reported by "X."

Under this general classification of foreign matter is included: Metal, which is determined by a simplified analytical scheme and classified as to source (that is, whether from bearings or ring and wall or other ferrous metal wear); water, which is classified either as free, or combined as emulsions; gums, tars, and residues, which are either derived from sludge deposits or formed coincidently with carbon formation in the upper cylinder region due to excessive heat; fuel soot, which is a product of incomplete combustion and ocurs when there is too much fuel and too little air; free carbon, the cause of which may be overloading, lean mix, late timing, or inefficient cooling, and dirt and sand, the presence of which in the engine means that either the air cleaners and breathers are inadequate or not functioning as they should or that this material is being poured into the engine with the lube oil due to contamination of the oil supply or improper care of oil filler cans.

A column on the face of the report form provides for an alphabetical and numerical key to descriptive material on the reverse side of the form so that the appropriate reference material relating to each individual report can be considered at the time the report is made. Comment is provided on each analysis by the laboratory relating specifically to each analysis and providing recommendations relative to oil change, flushes, purges, and filter changes and prescribing such tune-up and minor corrective work as is deemed advisable.

Sampling procedure demonstrated, using suction thief with stem extending to the bottom of crankcase.

It means very little to the gas engine man to be told that the oil from one of his engines has a certain quantity of ash and a neutralization number of a certain value, but it is significant and useful to be told for instance, that one of his engines is forming more carbon on the under side of the piston head than it should, and that if he would make a simple adjustment of ignition or carburetion he would probably remove the cause of excessive piston heat (indicated by the presence of carbon), which leads to early ring sticking and consequent rapid ring and wall wear.

By considering all the tests together, the important causes of controllable operating faults usually become apparent. For example, if the oil in an engine is abnormally thickened during a given period of service and there is evidence of considerable oil oxidation as shown by the sludge index, but no evidence of localized high temperatures such as excessive ring and wall wear or carbon from the under side of the piston heads, then it is a good bet that the engine is either overloaded or undercooled. If, however, there is this same evidence of oil oxidation but the viscosity has not

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Box 1492, Oklahoma City, Oklahoma

Laboratory technicians shown making routine inspections with specially devised mass production techniques. Samples are sent through the laboratory in groups of 48.

increased unusually and at the same time there is evidence of severe localized operating temperatures in the upper cylinder region as shown by rapid ring and wall wear or carbon, or both, then it is an equally good bet that it is a matter of adjustment, late timing and lean carburetion being the most frequent causes.

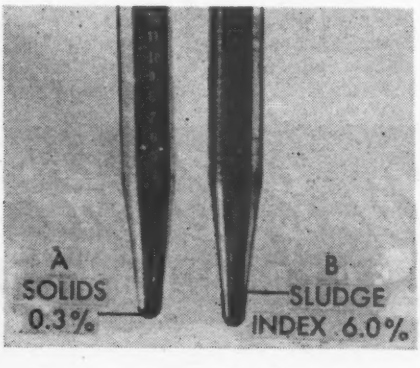
Similarly, the cause of excessive sludges in the crankcase, valve chambers, and other portions of the engine is usually apparent by considering the oil analysis as a whole. If the sludge index and solids volume are both high and at the same time water or emulsion appears in an excessive amount or traces recur, it would appear that the sludge is engendered by cold temperature operation and comprises what is commonly termed "emulsion sludge," the remedy for which merely involves changing operating temperatures or locating that particular portion of the engine responsible for the formation of this sludge and either insulating or ventilating that portion. The tip-off on high temperature sludge (which consists of resins, varnishes, or lacquers) is a high sludge index and high solids volume together with other evidence of high temperature operation, that is, thickened viscosity and frequent evidence that carbon deposits are forming.

If gas engines are not overloaded and all controllable operating faults are kept at a minimum it is not unusual for them to run several years continuously without the necessity for major overhauls. If, however, these controllable items are neglected, the frequency of complete overhauls might be doubled. A great deal can be accomplished by regular inspections and adjustments. In fact, if these inspections are frequent enough and complete enough, controllable operating faults can be greatly reduced and held to virtually nothing. The really disconcerting thing about any inspection system is, however, that all engines have to be inspected regularly to catch the few engines that actually need it. It is a fact that when the operation of an engine is improved so is the condition of the lube oil it contains. Therefore when crankcase oil analysis reports on a group of engines indicate those few needing attention and subsequent reports supply frequent reminders until the lube oil no longer reflects controllable operating faults, considerable purposeless oil and oil change time have been saved.

It is important when using crankcase oil analysis to realize not only what can be done through its use, but also what its limitations are. It is obviously not necessary to test crankcase oil to determine which engines are in need of major overhauls; those engines reveal themselves to the gas engine man with alarming frequency. In fact, the analyses from such engines are frequently misleading, for high oil consumption and consequent high make-up of new oil refreshes the crankcase oil to the extent that good analysis results may be shown. In this, as in other respects, it is necessary to use all the other information available as noted previously. When all data are fully correlated the result is an excellent basis for preventive maintenance achieved at minimum expense.

In addition to its role in the preventive maintenance scheme the system of crankcase oil analysis takes the guess work out of oil changes by defining the maximum safe use period for each engine by regular analysis. So long as the viscosity remains within safe limits, so long as there is no dangerous contamination, so long as the oil has not deteriorated and does not contain deterioration products, and so long as the oil retains its original detergent and dispersion properties, no danger can result from the continued use of the oil. All these items are readily apparent in the complete analysis from the viscosity determination, the identification and evaluation of foreign matter, and the solids volume and sludge index determinations considered separately and in combination. ★★★

A. Oil sample appears clean with little contamination revealed by conventional centrifuge test. B. Same sample after Sludge Index test that reveals true sludge potential.



NEW GLASS PRODUCT IS USED BY OIL INDUSTRY

By **V. SANDERS,** *Mechanical Engineer*
Pittsburgh Corning Corporation

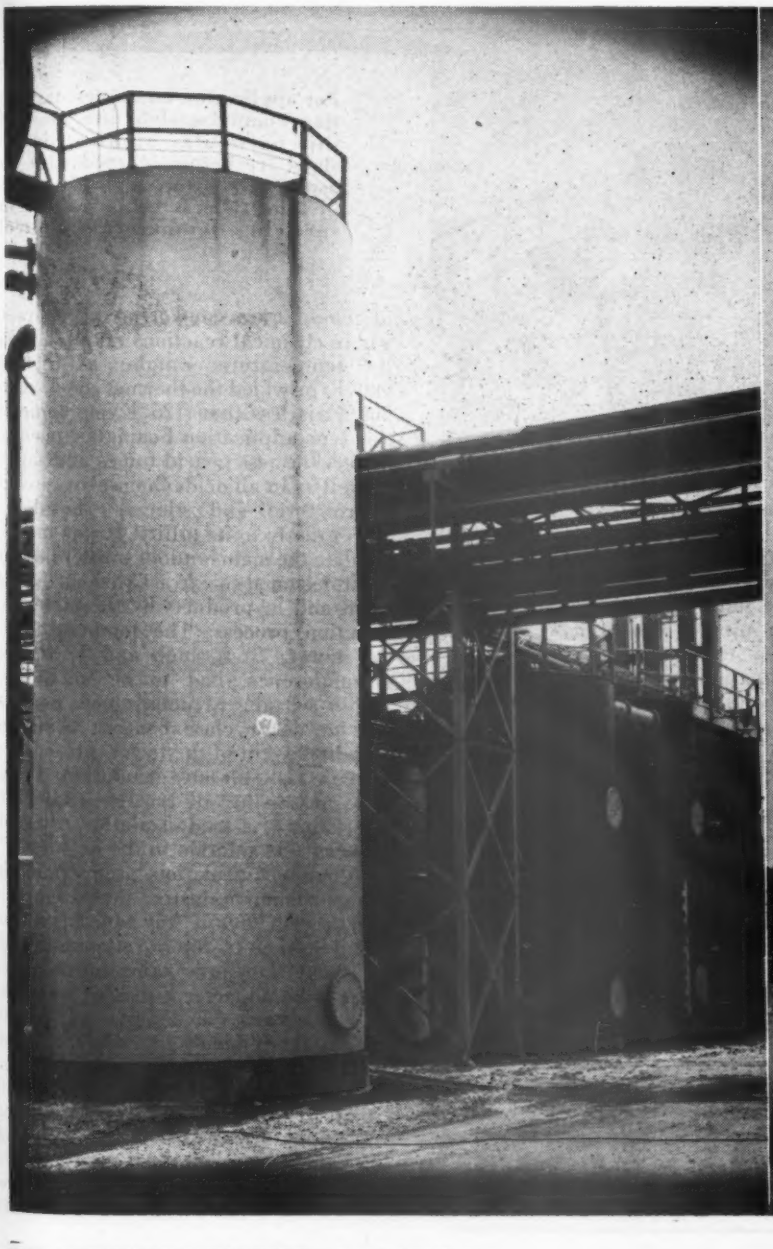
EXCLUSIVE One of the most effective insulations for industrial uses developed in recent years is the new glass product Foamglas, which has a cellular rather than porous structure. This inherent characteristic, combined with the inorganic properties of glass, makes it a material of special value where insulation is called upon to perform 100 per cent efficiently under difficult circumstances.

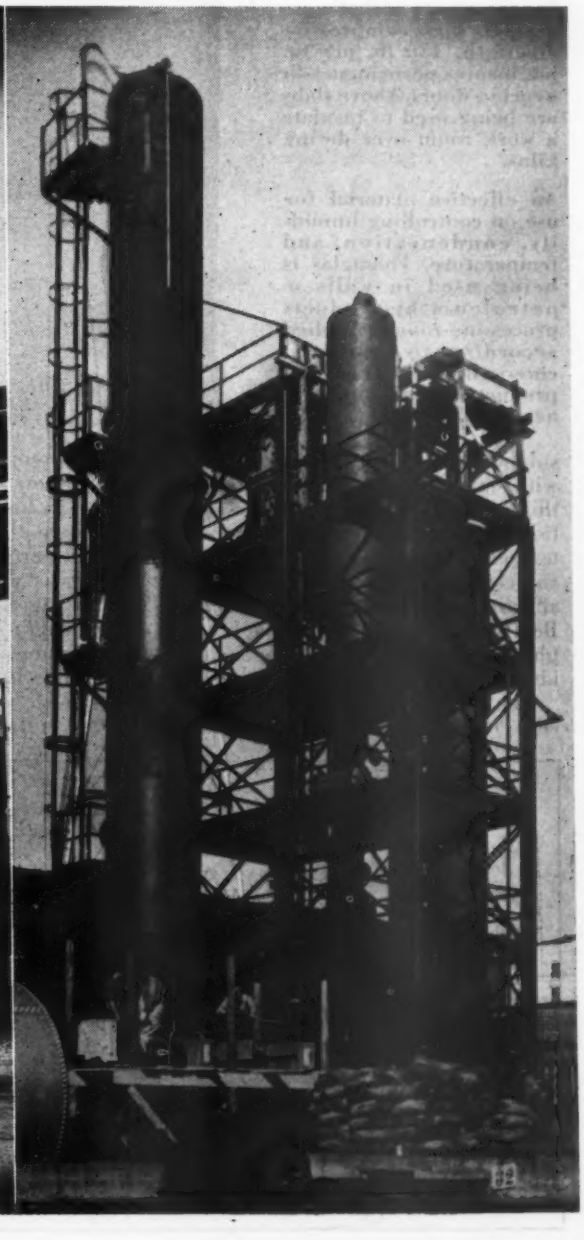
Outstanding asset of Foamglas, particularly as it relates to the petroleum industry, is its resistance to fire. This characteristic makes it valuable for use in tank skirts and tank supports where fire protection is of vital consideration. In tests conducted by the Pittsburgh Testing Laboratory, the material successfully withstood a 24-hr. exposure to a temperature of 1200°F. The official report stated "At no time during the exposure was there any evidence of combustion and during the test there was no loss in weight of the specimen, since weight before and after checked within less than 0.3 per cent." Actual installations as well as similar tests conducted by other groups have adequately demonstrated the fireproof characteristics of this new glass insulation.

Foamglas is adaptable for numerous applications in the petroleum and petroleum by-products industries ranging from insulation for use in pumping stations to thermal protection for huge heat exchangers. One large oil company has employed this material as a thermal in-

***Left*—Tanks, used in production of chemicals, are insulated with Foamglas. Being inorganic and cellular, this new material is impervious to the common elements causing deterioration.**

***Below*—Fractionation tower, part of the equipment used in obtaining paint oils and by-products through the molecular selection system. The glass product helps maintain a constant temperature.**





Above—**Insulating floors in war plants with Foamglas. Its high compressive strength, 150 lb. per sq. in., insures permanency in wearing floors. Above slabs are being used to insulate a work room over drying kilns.**

An effective material for use on controlling humidity, condensation, and temperature, Foamglas is being used in walls o petroleum by-products processing rooms. Applied according to standard core-wall procedure, the product insures a permanent insulation job.

For application on towers standard size Foamglas slabs are used. In this particular application the slabs are being adhered with hot asphaltic mortar. A double layer of 2-in. slabs is being used to insure close temperature control.

sulation for outdoor hot oil storage tanks with significant success. The problem in this instance was to obtain an insulation that would accomplish a positive temperature control job and yet not be subject to the deterioration commonly affecting exterior insulation applications. Being impervious to water, acid atmosphere, vapor, and fumes, Foamglas was ideally suited for the job.

The mechanical difficulties encountered in insulating a tank of this type were also reduced by the use of Foamglas, for the new insulation is light in weight, is easily handled, and can be cut and shaped on the job with ordinary tools. In this particular application, the Foamglas blocks were installed with steel bands. Its rigid nature and high compressive strength prevents it from slipping or warping.

The low percentage of heat loss obtained with the insulation opens possible use in the petroleum industry as a means of temperature control in large towers where chemical reactions take place under temperatures ranging as high as 900°F. provided the thermal shock above 300°F. is less than 125°F. per hour. In this type application Foamglas' peculiar imperviousness to acid fumes and vapors as well as to all acids themselves, except hydrofluoric and glacial phosphoric, adds greatly to its utility. It was used to insulate the main outdoor tower of equipment designed to extract various oils for paint and by-products by the molecular selection process. The temperature in this tower, 70 ft. high and 17.3 ft. in circumference, had to be maintained within certain predetermined degrees. The need for close control, combined with the height of the tower, presented a difficult task for any insulation. Foamglas, possessing all the essential characteristics of a true insulation material, provided the solution to the problem.

In outdoor insulation, predominant in the petroleum industry, permanency is a significant factor. Any type insulation that is subject to deterioration, automatically cuts into production inasmuch as it has to be replaced at regular intervals. This also causes a definite increase in the amount of money expended for maintenance. Glass, by its very nature, is impervious to the common deteriorants found in petroleum manufacture and processing. An insulation composed of glass would thus eliminate replacement jobs. This is a considerable factor where, for example, the insulation job would

TABLE 1

The physical properties of Foamglas

Weight	10.5 lb. per cu. ft. (average)
K (conductivity at 50°F.)	0.45 B.t.u./hr./sq. ft./°F./in.
K (conductivity at 300°F.)	0.70 B.t.u./hr./sq. ft./°F./in.
Coefficient of expansion (F)	0.0000046p per °F.
Specific heat	0.16 to 0.19 B.t.u. per lb. per °F.
Crushing strength	150. lb. per sq. in. (average)
Modulus of rupture	90. lb. per sq. in. (average)
Absorption (24-hr. immersion in water)	Average 2% by weight (all at surface)
Air infiltration or permeability	0
Volume change with moisture	0
Capillarity	0

Sizes and packing

Standard sizes	Pieces per carton	Sq. ft. per carton	Approximate weight per carton
12 x 18 x 2	12	18	38.0 lb.
12 x 18 x 3	8	12	37.5 lb.
12 x 18 x 4	6	9	37.0 lb.
12 x 18 x 4½	6	9	41.5 lb.
12 x 18 x 6	4	6	37.0 lb.

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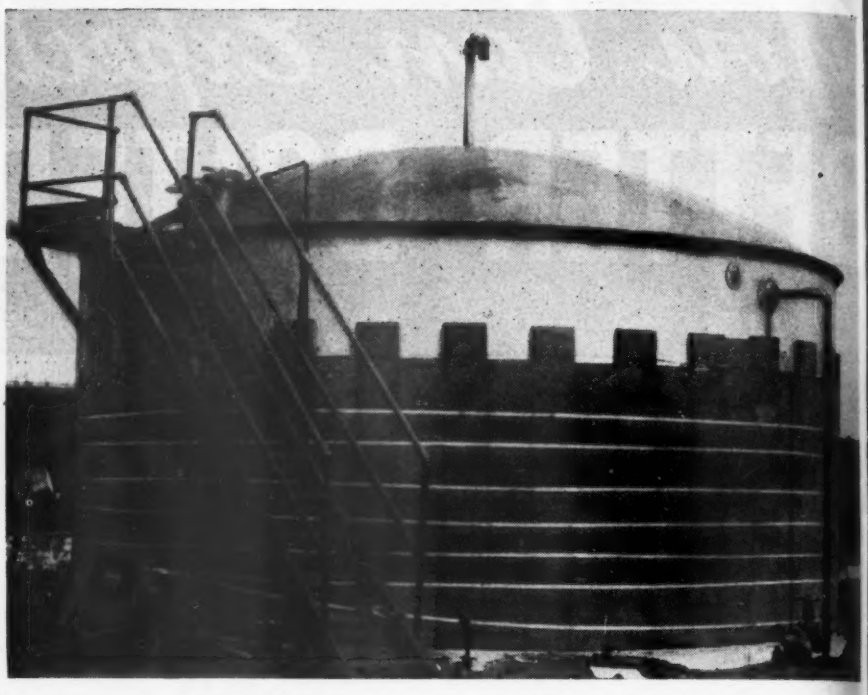

When used on hot oil storage tanks, Foamglas is applied with steel bands. The rigid nature of the insulation, being able to support up to 30 times its own weight, prevents slipping and packing. It is valuable in this type application for it will not absorb moisture in any form.

be one on a huge tank involving scaffolding and other apparatus. The high compressive strength of the product, 150 lb. per sq. in., makes it an efficient insulating material for tank tops, roofs, and other areas where foot traffic occurs, when applied according to standard procedure.

Foamglas has proved useful in plants manufacturing petroleum by-products where temperature control, humidity control, and condensation pose particular problems. In one particular application where condensation was not only emulsifying the product but was causing building decay, Foamglas was applied in core-wall construction on both outer wall and interior partitions as a thermal insulation. In this instance the humidity factor was predominant and the insulation previously used was inadequate as a result of its inability to withstand water absorption. This absorption, in addition to rotting the insulation, also raised the heat conductivity of the material as a direct result of its increased water content. Being inorganic, Foamglas does not absorb water or moisture in any form, a factor that made it ideal for this application.

The permanent nature of Foamglas is appreciated where used in core-walls as protection for processing rooms. It is no easy matter to rip out walls and reinsulate from time to time, as is necessary where the insulation becomes so sodden and packed as to be valueless. In a series of exhaustive tests, Foamglas was proved to be vermin proof and incapable of penetration by insects or rodents.

Foamglas is produced through a reaction of ordinary glass and carbon. Specially prepared, pulverized glass is mixed with pure carbon and baked in ovens operating at very high temperatures. Carbon gases are then formed causing cellulation of the molten glass. The result is a product of which 1 cu. ft. contains more than 5,000,000 cells of inert air hermetically sealed—a material that will maintain its insulating and moisture-proof efficiency permanently.

Wartime uses of Foamglas include application to various types of U. S. Navy flotation apparatus such as anti-submarine nets and life rafts. It is also being used as insulation in ship construction where permanent resistance to water and fire is a vital consideration. The new insulation is finding use in war plants in applications ranging from thermal control of large processing areas for rubber products to insulating frozen food storage areas. Many new and different uses for this cellular product will undoubtedly be found in the petroleum industry for tanks, heat exchange apparatus, ovens, furnaces, and other units as well as in the roofs, walls, and floors of oil field buildings and offices.

★★★

Venezuelan discovery

Atlantic Refining Company has discovered commercial production with its first well drilled in Venezuela. The well, No. 1 Avida, is on the Pirital block under contract with Pantepec Oil of Venezuela. Oil is of 32.8-gravity.

Under agreement with Pantepec, Atlantic was to have exercised its right before April 1 to acquire a 50 per cent interest in the block. Due to wartime delay in obtaining materials, however, the date has been extended by Pantepec until June 1.

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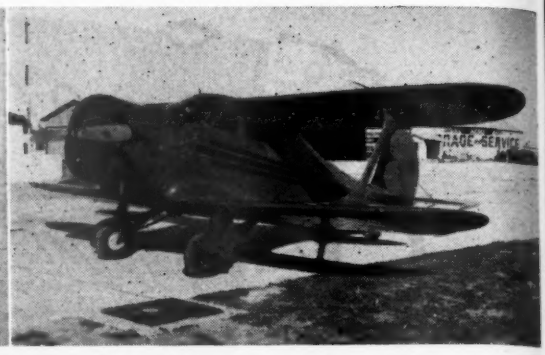
Aerial Surveys for PIPE LINE CONSTRUCTION

By JACK AMMANN*



1. Aerial survey airplane (Beechcraft).

EXCLUSIVE THE achievements in aerial surveying and aerial mapping have been known to the petroleum industry for many years. The present wars are demonstrating the exacting results that must be obtained from an aerial survey. If this type of survey had not fulfilled every expectation of the armed forces, the system would have been discarded immediately.

Specifically, there is no better means of portraying the earth's surface than by an aerial survey. There are hundreds of features that cannot be shown by any other means. Through clear-cut principles of photogrammetric engineering, the accuracy of an aerial survey can be specified and map finished to any scale.

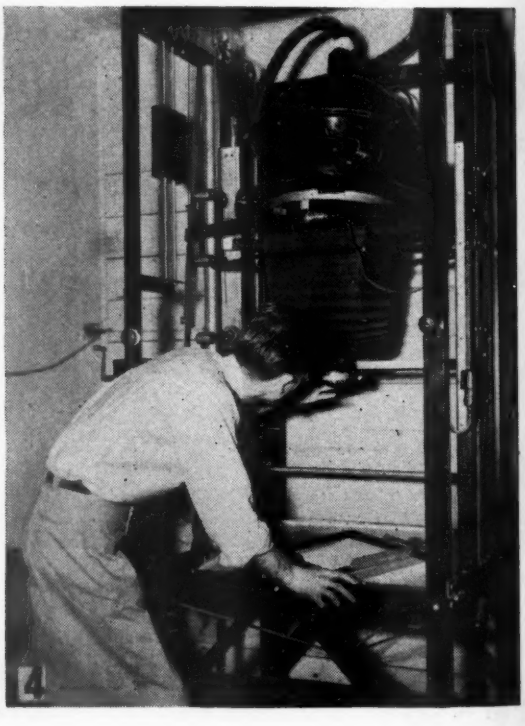
Generally, the less accurate type of map is in current use today. Possibly this is due to a somewhat higher price for an engineered, or controlled type of aerial survey. For this reason, many of the oil and pipe line companies have never experienced the results that can be obtained from an aerial map constructed in accordance with specifications as detailed by the American Society of Photogrammetry.

Surveys for pipe line construction represent several problems, each separate and distinct from the other. Depending on the type of line to be constructed, a survey is planned accordingly. An aerial survey is no panacea, but a vast majority of all the problems involved in such planning can be solved by the use of an aerial survey map.

Primarily, the type of terrain and the size of land tracts that follow the proposed route are major considerations in the construction of most pipe line projects. Aerial survey maps immediately show the character of the terrain and the size of the tracts. Special maps prepared by photogrammetric means show the actual contours of the terrain. These contours can be shown in several different ways. Contours of practically any interval may be drafted directly on the aerial survey map and in their correct geographic position. They may be constructed and shown on a celluloid overlay sheet so that when registered on the aerial survey map, the contours will be in their correct positions. These contours may also be constructed and prepared as an ordinary line map.

Aerial topographical maps, such as described above, are constructed through the use of a Zeiss Multiplex. Less accurate contours may be constructed through the use of a measuring stereoscope by means of a parallax bar. This type of contouring is comparable to ordinary plane-table surveying. For precise work, however, the multiplex is by far the more desirable instrument.

*President, Jack Ammann Photogrammetric Engineers, San Antonio, Texas.



2. Planning the aerial survey.

3. Slotted templet lay-down for controlled aerial survey mapping.

4. Rectifier—removing the effects of error in aerial photographs.

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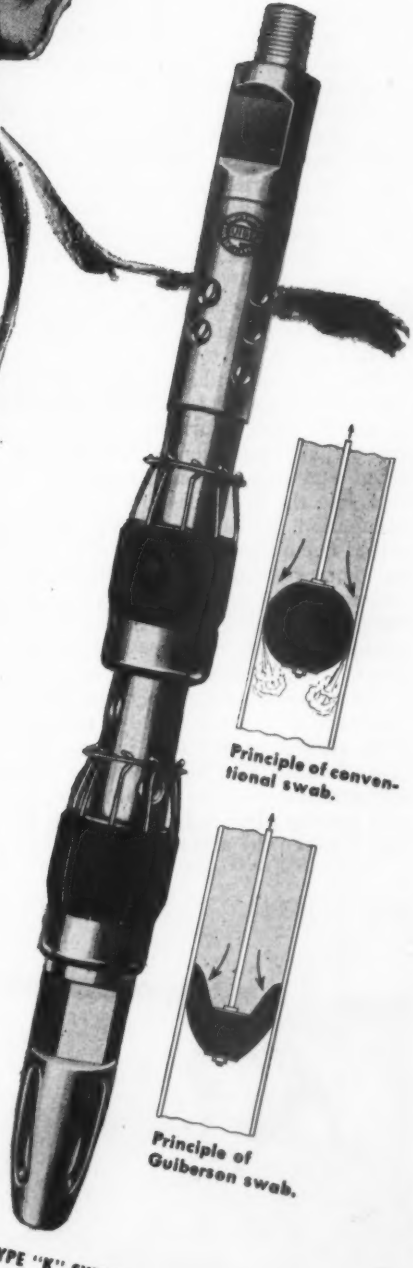
The Type K Swab with exclusive Guiberson flexible basket type fluid cups can really take it on the tough jobs. Flexible cup construction prevents wear while running in the hole and allows cup to take up its own wear while swabbing. And when it comes to dishing it out, the Guiberson swab falls faster than the swabbing line will unreel from the drum and gives greater fluid passage through the mandrel than any other make of swab. Pulls a full load at every stroke. Cups are easy and quick to change. Available in all standard sizes, the cups will fit slightly varying diameters of tubing and casing.

The Guiberson flexible basket type swab takes up its own wear, assuring a complete seal even after cup begins to wear. Swab cups are Guiberson's own special rubber compound that resists abrasion and gives maximum tensile strength.



TYPE "K" SWAB

Principle of conventional swab.

Principle of Guiberson swab.

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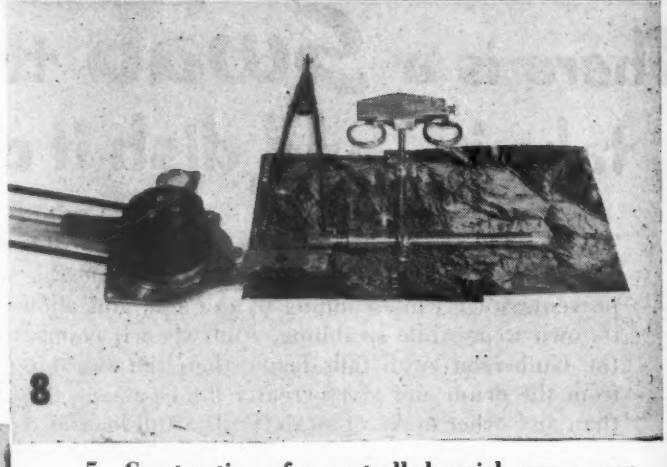
This type of engineering equipment recreates for the operator's table the identical terrain conditions as viewed by the aerial camera at the moment of exposure. By using a tracing table and a floating beam of light, the elevation of the ground is determined accurately. Such planimetric features as desirable are also determined. It is through this means that topographical maps are prepared by the army, the TVA, and the U. S. Geological Survey. One of the recent construction projects was that the Possum Kingdom Dam on the Brazos River. All topographical maps and practically all the remaining maps were constructed by the aerial survey method.

The size of a land tract can be determined in a general way by examination of the aerial survey map exclusive of any other map. As the scale of the map is known, the number of acres in a particular tract can be determined through area computations of triangles, rectangles, etc. This acreage can also be determined by the use of a planimeter. A registering overlay, or a line drawn map that incorporates such information as the property owners, roads, rivers, creeks, woodlands, etc., however, is probably the best for ownership and planimetric determination. These should be made from a controlled aerial survey.

Property ownership or regional base maps cannot be constructed accurately from deed descriptions and survey records alone, for such information does not take into consideration the actual occupation of the ground. Such maps, however, when constructed from a controlled aerial survey as a base, correlate the legal descriptions with the visible evidence of occupation. When it is obvious that an error exists between actual occupancy and legal descriptions, field investigations and surveys will determine tangible tie-ins such as survey corners, fence corners, and property corners, the resulting lines representing the acceptable property between the adjacent owners. Excesses and vacancies are immediately apparent through this means of map construction.

The aerial survey map to be used in connection with the construction of a pipe line, or used in *any type* of route planning, should be one that incorporates the very latest aerial photographs. The value of any aerial photograph, aerial photographic map, or aerial survey to be used in connection with routing plans is limited greatly by the amount of elapsed time between the aerial survey and the planning. This is most



5. Construction of a controlled aerial survey map.
6. Delineating property information on aerial survey field sheets.
7. Zeiss multiplex—construction of contours.
8. Measuring stereoscope.
9. Drafting topographic and property information on celluloid overlay sheets.

significant in practically any section of the United States because of extensive highway construction, rural developments, and improvements being carried out year after year. The greatest consideration should be given in this connection in an effort to obtain the most recent aerial survey in such planning work. This is necessary also because such features as roads, fence lines, creeks, rivers, etc., have been found upon investigation to have changed from their original

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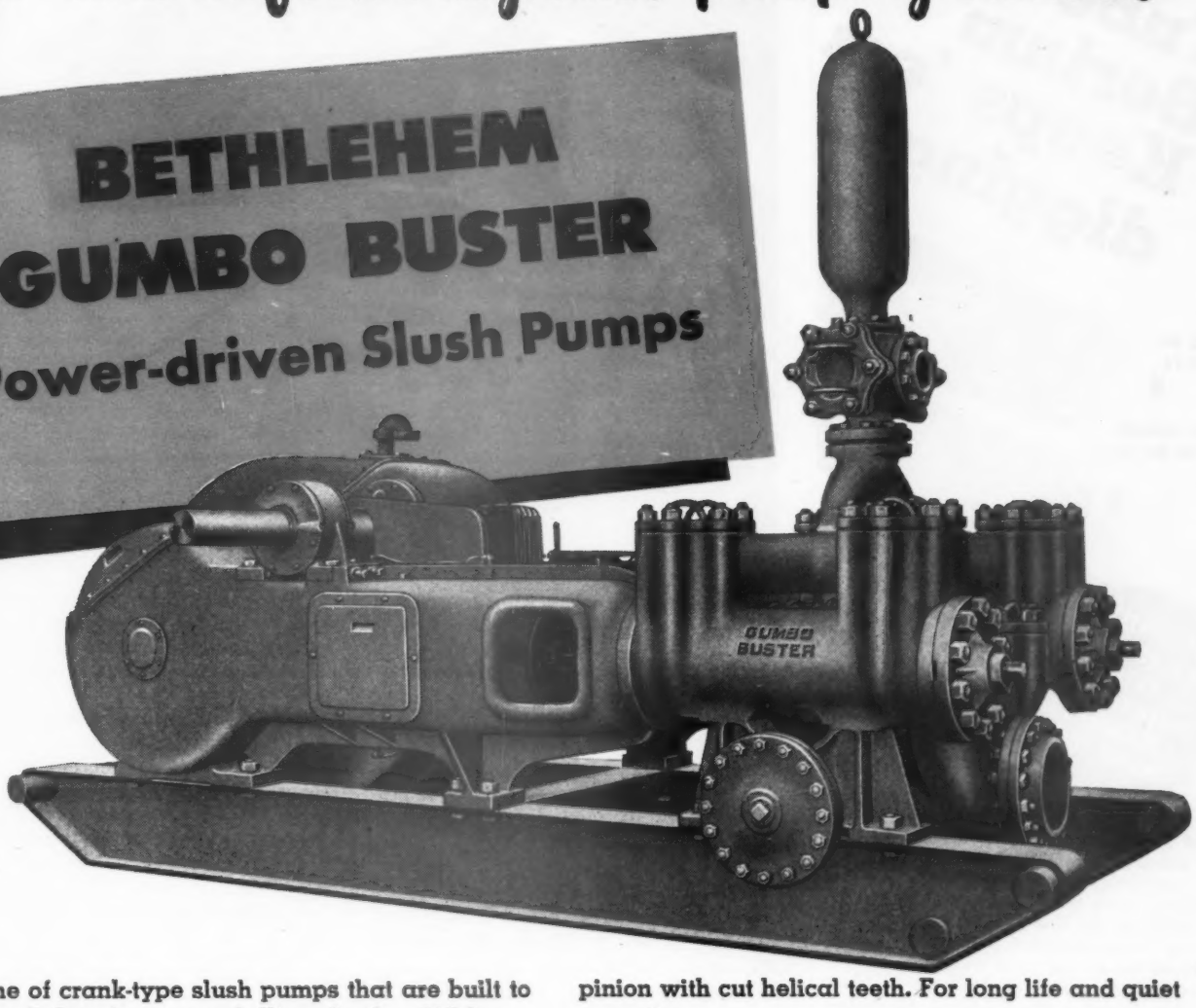

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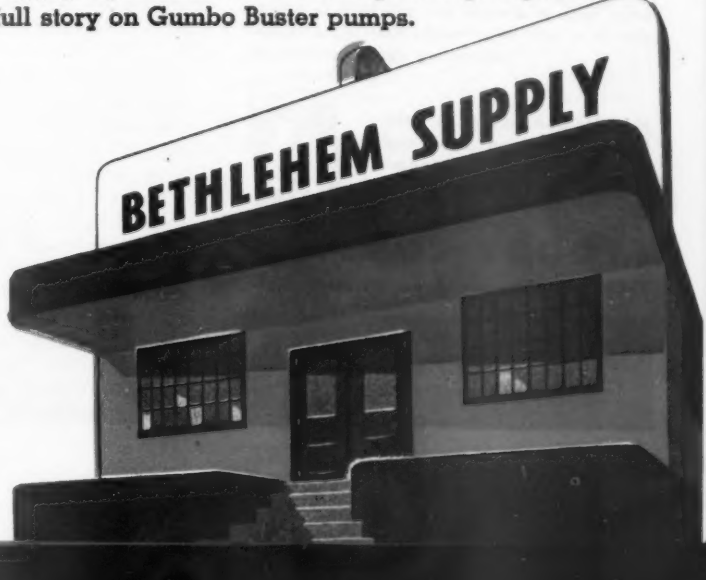
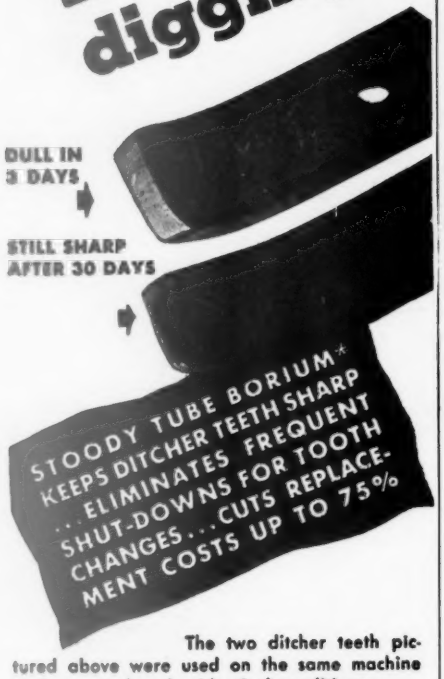


Tube Borium Keeps 'em digging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STILL SHARP AFTER 30 DAYS
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The two ditcher teeth pictured above were used on the same machine and operated under identical conditions.
The unprotected tooth at the top had to be sharpened every three days and was too short for further service after six sharpenings.
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Before the tooth was finally worn out, it had operated a total of 120 days!
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These tungsten carbide particles do not melt when tube is applied but are held in suspension in a mild steel matrix forming a deposit resembling coarse sandpaper.

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10. Drafting property information on celluloid overlay sheets from survey.

location in a very short period of time. For the best results, the aerial photographs used in connection with tentative routing should be those taken only a few days before the actual planning of a pipe line project.

Each picture in the resulting controlled aerial survey map should be scaled and the error determined. These pictures in turn should be rectified and the effects of the error removed. This is determined through radial intersections of slotted templets. These corrected pictures are assembled and laid into the final map.

One of the more recent pipe line projects of a major company was the construction of a pipe line that would result in oil flowing by gravity for a distance of several hundred miles. The purchase of scarce pumping units, as well as the savings involved in the operation of such equipment, were points of major consideration if the plan could be accomplished. The aerial survey method was decided upon in view of the truer expressions of the ground, the time factor for the preparation of the maps, and the lesser expense involved for their construction. An aerial survey crew was immediately placed on location for the accomplishment of new aerial photographs. Several days later, this photography was shipped to a processing plant and the map construction was initiated. The maps were constructed in 7½ minute grids, i.e., 7½ minutes of latitude and 7½ minutes of longitude. After the first several grids had been completed, the property information and the topography were initiated. Aerial survey field sheets were sent to abstract crews in the particular county and property lines, survey lines, owners' names, rendered acreage, etc., were delineated directly on the aerial survey field sheets. Concurrently, such vertical control as was necessary for the construction of the topography was begun. This process was followed through to the end of the field work when all sheets were returned to the processing laboratory. The property and the topographical data were carefully assembled, checked, and redrafted on celluloid sheets. These celluloid sheets in turn were photographically reproduced to precisely the same scale as the aerial survey. The final products delivered were controlled aerial survey maps in 7½ minute grids with a registering overlay giving all property information and 5-ft. contours.

It is this writer's opinion that no other map could have represented any other information than that described above, considering the pipe line problem involved.

There are possibly several other problems that are presented in planning a pipe line, however, it seems that the purchase of easements and following the flattest ground possible along the shortest path are the most important of these problems. It is these two features that an aerial survey, with the accompanying overlay as above described, most truly accomplishes.

For the pipe line engineer and for the petroleum industry will come a very important announcement following the cessation of hostilities. Color photography in its finest aspects will be initiated for current use. Aerial surveys in natural color will be as common as the black and white photographs of the present time. Such matters as the true color of vegetation, the actual course of bedding, and the porosity determination of certain soils will be immediately apparent through controlled natural colored aerial surveys. ★★★

HANG UP NEW SAFETY RECORD

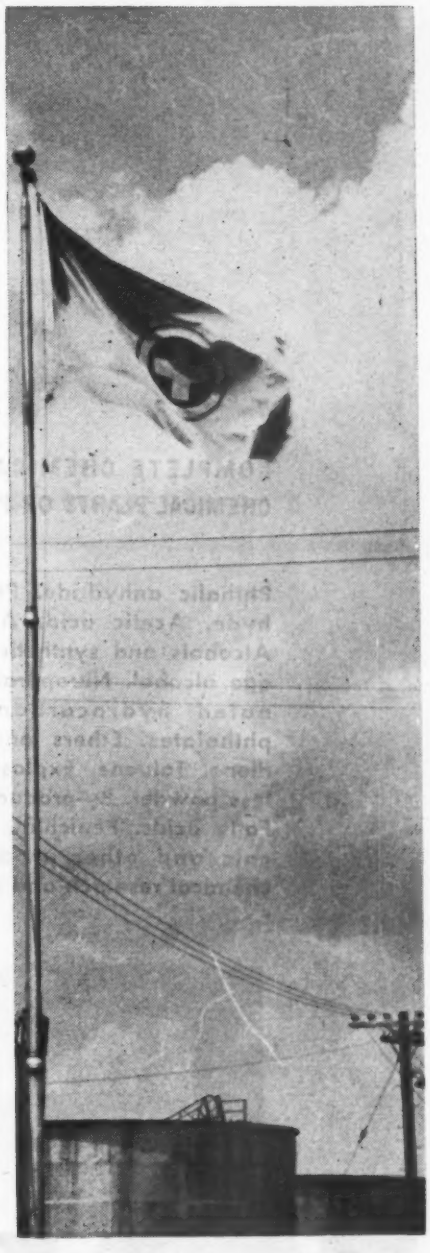
By **J. F. GOLDSBERRY,** Shell Oil Company, Inc.
Chief Engineer, Wood River, Illinois, Refinery

ALTHOUGH the Wood River, Ill., refinery of Shell Oil Company, Inc., has been greatly expanded and many new special units added since the beginning of the war, the safety record has not only kept pace but has been improved. This is all the more significant in view of: (1) longer work week and frequent overtime due to manpower shortage; (2) the addition of many hundreds of new employes, some of whom are women hired with little knowledge of the work required; (3) the use of older tools in maintenance and frequent substitution for critical materials, and (4) the usual wartime conditions such as distraction, worry, speed, and necessity of producing maximum amounts of products.

The refinery safety department is composed of a staff safety chairman, head safety engineer, and seven safety inspectors. This organization, in collaboration with other departments, assumes the responsibility for all safety instructions and safe working conditions throughout the plant. Safety has always been stressed in the plant and a low accident frequency record maintained. However, at the beginning of the war when considerable construction activity had already started and accidents were on the increase, it became evident that more activity is safety work was necessary if accidents were to be held in line.

The safety organization started an intensive drive to make everyone safety conscious, with a firm belief that accidents need not happen in spite of the unusual conditions being experienced. As a result, the safety record has actually improved. This refinery is now one of the few plants in the petroleum industry in which the accident frequency has been lowered since the start of the war. In this period the refinery safety record has been exceeded twice and a total of

(Continued on Page 138)



Just outside the gate to the Wood River refinery flies the safety flag in recognition of 3,205,000 manhours worked with one disabling injury. *Left*—Directly responsible for putting into practice the precautions that made the record possible are the members of the refinery's safety staff, a division of the engineering department. Left to right, they are: R. A. Randels, head safety engineer, B. C. Cole, E. S. Quillen, J. S. Brien, G. L. Moorman, Jr., C. A. Nicolet, J. F. Goldsberry, refinery chief engineer who is safety chairman, A. T. Smith, and E. B. Wiley, Jr.

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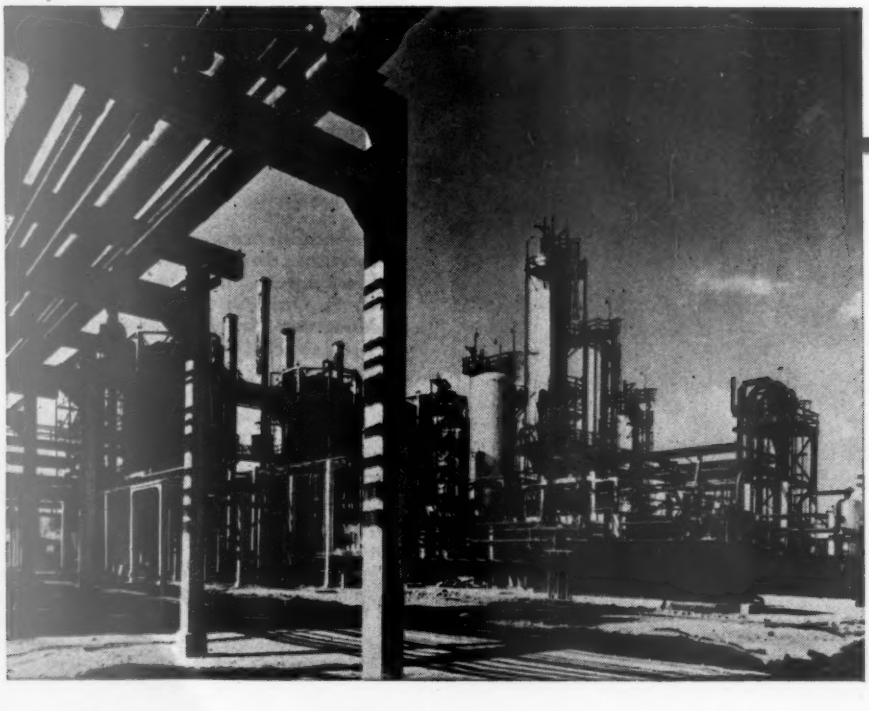
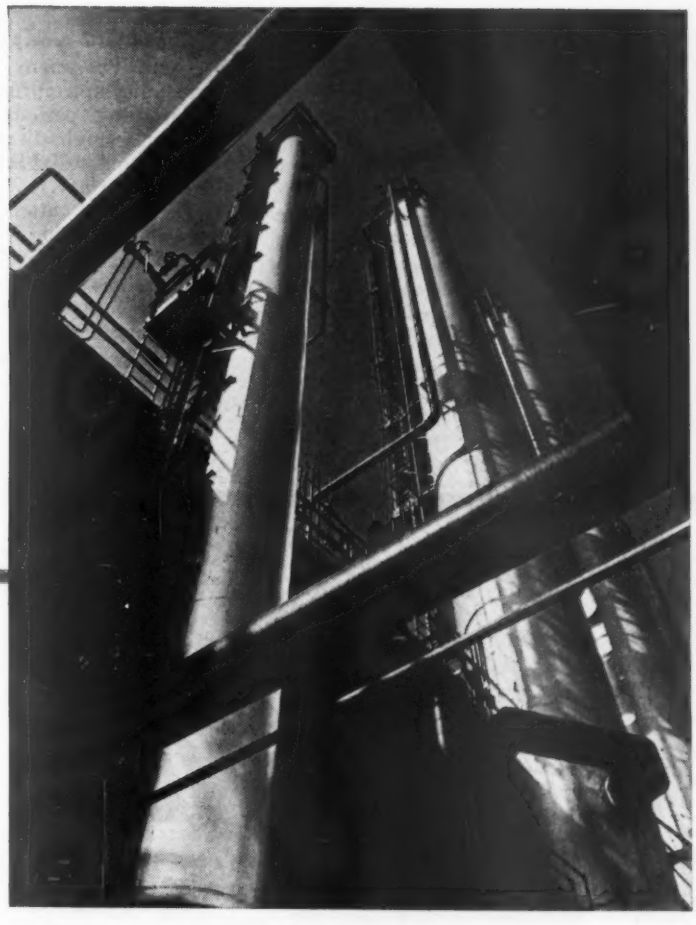
Badger will build



COMPLETE PETROLEUM REFINERIES



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PROCESS ENGINEERS AND CONSTRUCTORS FOR THE PETROLEUM, PETRO-CHEMICAL AND CHEMICAL INDUSTRIES

(Continued from Page 135)

3,205,000 manhours worked with one disabling injury. It may be added that the records are in no way influenced by injured employes returning to what is known as "light duty" to avoid disabling injured employes returning to what is judgment is final in this respect.

The present average accident frequency for the refining industry as reported by the United States Department of Labor is 11.8. In comparison, this refinery's frequency record over the past 5½ years including July 1944 is as follows:

1939	2.51
1940	1.50
1941	3.75
1942	3.39
1943	2.89
1944 (7 mos.)	1.77

There are many departments that have hung up impressive safety records by working periods of several years without a single disabling injury: (The number denotes years worked since last disabling injury.)

Tool room attendants 20, cooling water system 20, lube treating heavy oils 18, blacksmiths 18, shop machinists 18, storehouse attendants 17, laboratory 16, lead burners 12, slop recovery 10, surveyors 9, switching 9, loading and unloading 9, lubricating laboratory 9, gas plant 8, coke disposal 8, brickmasons 7, lube vacuum stills 7, riggers 7, lube dewaxing 6, lube filters 6, electricians 6, cranemen 4, and welders 3.

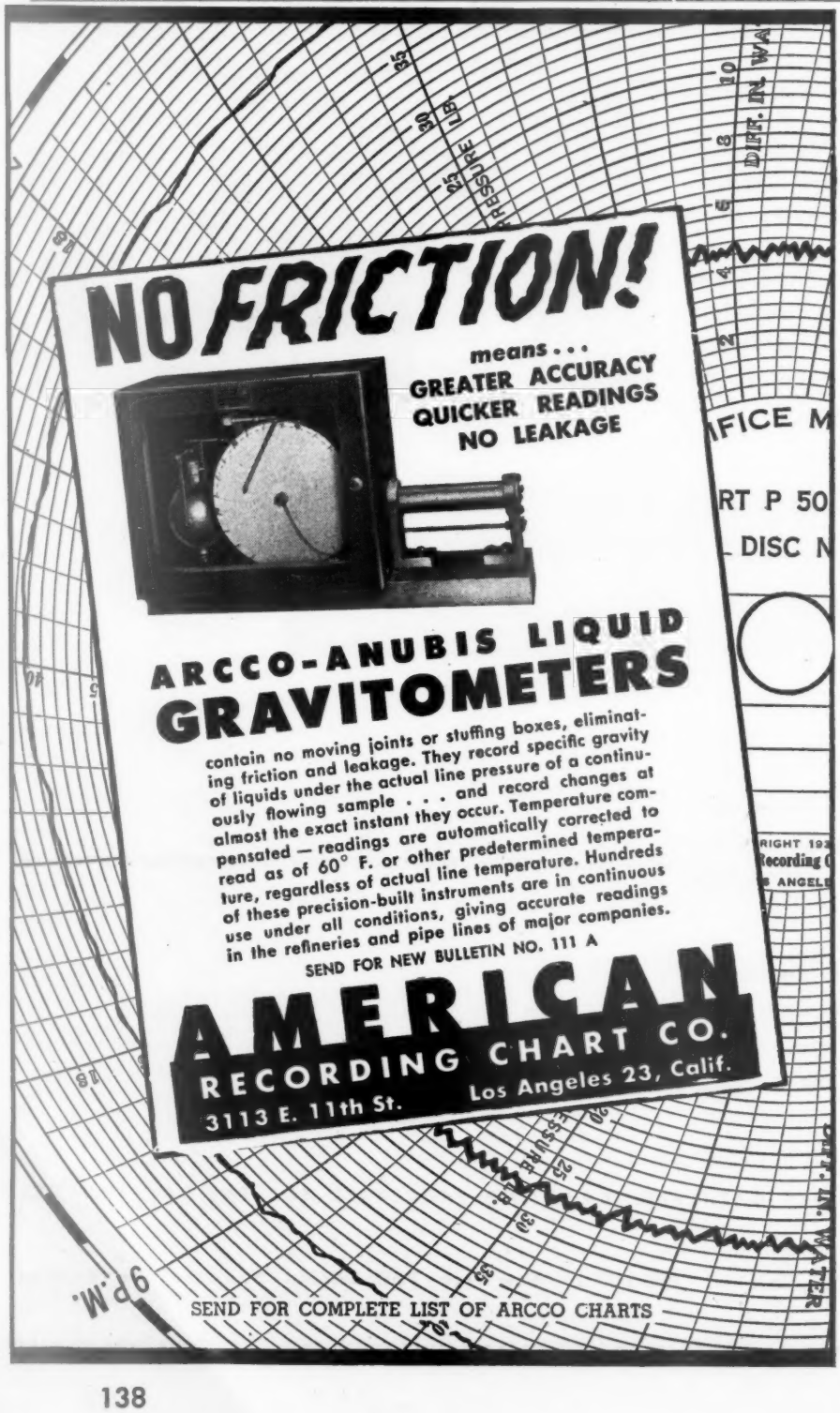
These safety records are attributed to constant teaching of safety thinking and a diligent application of safe working methods. Safety thinking and safe practices become a matter of salesmanship, which, when accepted by the employes, require only normal effort to continue. Supervision must first become interested and sold on safety, as experience has taught that unless safety thinking starts from the top full benefits will not be reached on the way down. To accomplish this the old maxim "to increase interest, give a person something to do" was employed. Accordingly, all supervisors were given an opportunity to lead meetings. In this manner it was soon discovered that there was an abundance of latent safety leadership that had never taken special interest in safety work. It was also found that this interest increased the more the supervisors became involved in the work.

Approximately 50 safety meetings are held each month. All maintenance and construction employes attend meetings of one hour's duration. In some departments where it is more convenient, small group sessions are held weekly. All employes with the exception of the office workers attend these meetings.

Special attention is given to the subject matter and the method of conducting meetings. A poorly conducted or uninteresting meeting makes little impression on the employes. The leaders are chosen from the entire refinery staff in accordance with their ability. Not everyone is qualified to conduct meetings although he may be entirely sold on safety. Therefore, only those who have the desire and possess the ability are requested to lead meetings.

In all meetings, safety thinking is stressed and, in particular, near accidents are discussed. The interest of employes is easily held on such subjects. Suggestions are requested but not dwelled on for any length of time as in most instances they require investigation and then are handled personally with the suggester. All suggestions are disposed of as quickly as possible by means of a letter advising of their final disposition. Good housekeeping is not allowed to consume too much time in the meetings. Disabling injuries in the plant are thoroughly aired along with action taken to prevent recurrence. The prime purpose of the meeting is to promote the feeling among employes that they have a duty in safety work and are, in a sense, all safety inspectors.

Active interest of staff members also stimulates the work of the regular inspectors. These inspectors have been trained so that in promoting safety work they are able to obtain the cooperation of the foremen and employes. They have been carefully chosen and possess years of refinery experience. They are men of good personality and by nature are patient and cooperative. They understand that safety cannot be forced but must be obtained through educating the employes to think and want to do a job safely whether an inspector is around or not. ★★★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BOILER MAINTENANCE IN REFINERIES

By **F. X. GILG,** The Babcock and Wilcox Company

EXCLUSIVE DURING these critical times when oil refineries are operating at full capacity to provide the fuels necessary to maintain the country's war effort, the steam generating equipment must be kept in good condition to meet the greatly increased requirements. Even though oil refineries are such a vital part of the war effort, it has been necessary to stretch the steam generating capacity of their existing equipment to the limit, as only a few new boilers were released for manufacture and these were assigned to those refineries with the most critical needs. Therefore, the burden of maintaining the steam generating equipment of refineries in good repair has rested on the boiler room personnel, and by and large they are doing an excellent job.

Because the steam plant in a refinery is required to burn unmarketable waste fuels such as acid sludge, tank bottoms, petroleum coke, and refinery gas, all of which are contaminated with chemical residue from the refining processes and frequently are of an acid nature, boiler maintenance includes some problems that do not generally occur in boiler rooms.

The liquid fuels available in a refinery boiler room, consisting of heavy oils, acid sludge, and tank bottoms, generally are burned in steam-atomizing burners of which there are several on the market. A type of burner that has worked quite satisfactory with these heavy fuels is shown in Fig. 1. The fuel is piped to the burner at low pressure and temperature, where it is atomized by steam into a fine mist as it leaves the sprayer plate. The air for combustion enters tangentially through adjustable registers as shown in the assembly view Fig. 2. These burners can be readily arranged to burn gas by adding a gas ring (manifold with gas burner holes) as shown in Fig. 3.

The principal items of maintenance in such a burner are the sprayer plate and the impeller plate. Even though the sprayer plate is made of acid resistant materials, the orifices will erode because of the grit or carbon particles entrained in the fuel. These sprayer plates, however, are easily replaced. The general practice is to have a completely assembled spare barrel or center piece with the sprayer plates enclosed, so that it is a relatively simple operation to disconnect the quick-detachable oil and steam hose, remove the barrel assembly, and replace it with the spare assembly containing the new sprayer plates. An alert operator can tell by the appearance of the flame when the sprayer plates have deteriorated to a point where combustion is affected. Impeller plates become oxidized by overheating if they are set too far into the burner throat.

Increased demands on steam generating equipment make it essential that plant be kept in good operating condition.

Petroleum coke is generally burned in pulverized form, with a burner such as that shown in Fig. 4. This burner can also handle liquid and gaseous fuels, singly or in any combination. Like all refinery waste fuels, petroleum coke is extremely variable in characteristics. Analyses of samples from three different plants are as shown in Table 1.

The Hardgrove grindability index, which is a standard used in comparing the relative grindabilities of solid materials (the higher the index number, the easier the material lends itself to grinding) is about the same for these three samples. We have encountered samples, however, with a grindability index as low as 35, which causes exces-

TABLE 1

	Sample No. 1	Sample No. 2	Sample No. 3
Moisture, per cent	7.8	1.21	5.9
Volatile matter, per cent	13.8	14.12	42.3
Fixed carbon, per cent	77.7	80.27	50.9
Ash, per cent	.7	4.4	.9
	100.0	100.0	100.0
Sulphur, per cent	4.5	2.4	6.3
B.t.u. per lb. A.F.	13,900	14,972	11,700
Grindability (Hardgrove)	65	56	65

TABLE 2
Refinery gas

	By vol.
Methane	25.0
Ethylene	4.3
Ethane	15.1
Propylene	5.3
Propane	22.6
C_nH_x olefins	1.6
Sat. butane	10.0
CO	1.8
Residuals (N_2+H_2)	14.3
	100.0

Sulphur (H_2S).....152 gr. per 100 cu. ft.

F. X. GILG graduated from Cooper Union in 1923 with a B.S. degree in mechanical engineering. He continued graduate work at Columbia University and Brooklyn Polytechnic Institute, receiving an M. E. from Cooper Union in 1926. He has been employed by Babcock and Wilcox since 1921.

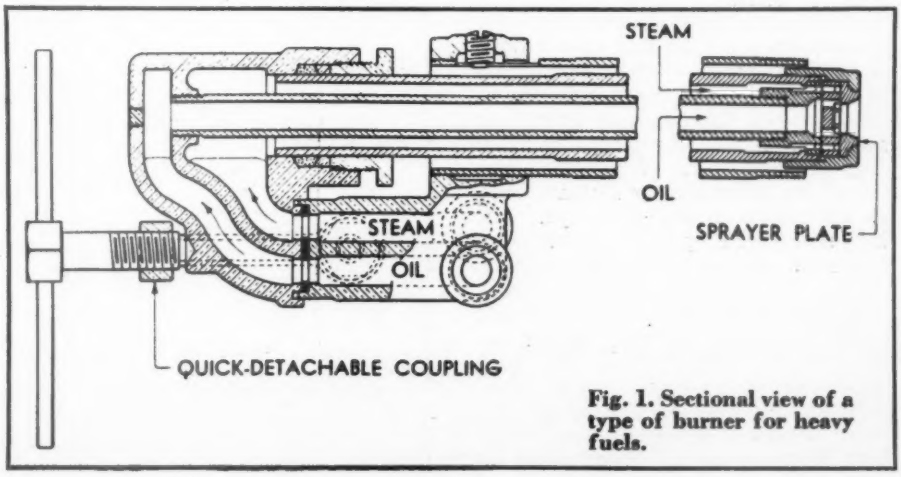


Fig. 1. Sectional view of a type of burner for heavy fuels.

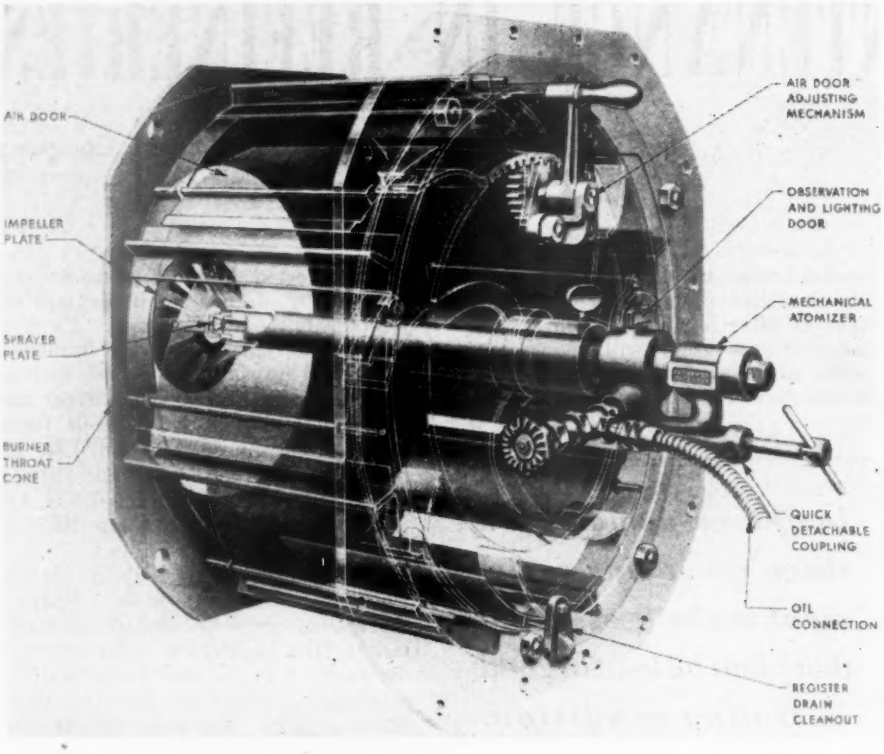


Fig. 2. Assembly view of adjustable register.

tegral-furnace boiler that can readily burn any of the heavy fuel oils, acid sludges, and refinery gases in the multi-fuel burners. In these furnaces, there is almost no refractory area that is not water-cooled and, therefore, there should not be much if any furnace wall maintenance. Another type of completely water-cooled furnace boiler operating on liquid, gas, or pulverized petroleum coke is shown in Fig. 6.

Even though furnaces are completely water cooled, the vicious nature of deposits from burning waste fuels causes some difficulties due to fouled heating surfaces of the furnace, boiler, superheater, economizer, and airheater.

● **Slag deposits and analysis.** The deposits on furnace, boiler and superheater tubes, take the form of a hard scale, which is difficult to remove while a boiler is in service because they adhere so tenaciously to the heating surfaces. Ordinary sootblowers are not very effective in removing these deposits. Special sootblowers using the mass action of large

sive wear of pulverizer grinding elements. Maintenance of the fuel burning equipment for pulverized petroleum coke will be the normal maintenance expected from the grinding elements plus maintenance of the fuel handling equipment due to corrosion resulting from the moisture and high sulphur content of this fuel. As a matter of fact, in some refineries it has been found necessary to lead-line the fuel handling and storage equipment.

Refinery gas is generally burned in gas rings containing small holes directed toward the furnace and into the air stream, as shown in Figs. 3 and 4. Refinery gas also is a variable fuel. An analysis of one sample from a refinery in the southwest is shown in Table 2.

Because of the temperatures to which the gas rings are subjected, they are generally made of a heat-resisting alloy, so that there should be little maintenance except an occasional cleaning of the gas burner holes.

The fuels that contain certain chemical constituents from the refining processes will cause troublesome deposits in the furnace and on the heating surfaces. If the furnaces are refractory lined, some of these chemical constituents may act as a violent flux on the brickwork and cause severe slagging and brickwork maintenance. It is surprising how much slag accumulates in a furnace, even though the analysis of the fuel may show an ash content of less than 1 per cent. It is also surprising to see the effect on brickwork of some of these constituents, such as lime, titanium, vanadium, etc.

Because of the wide range of fuels that a refinery boiler room must use, virtually all recent boiler installations are of the completely water-cooled type to reduce furnace wall maintenance. Fig. 5 shows a type of low head room, small floor space, completely water-cooled in-

Fig. 3. Arrangement for gas-firing burners.

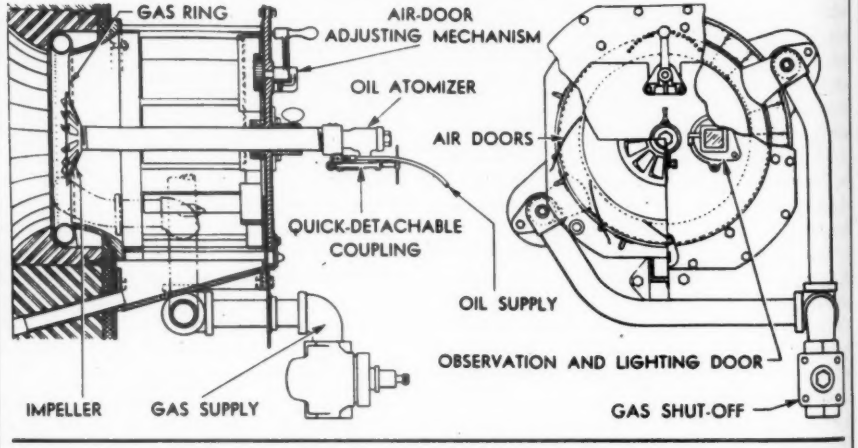
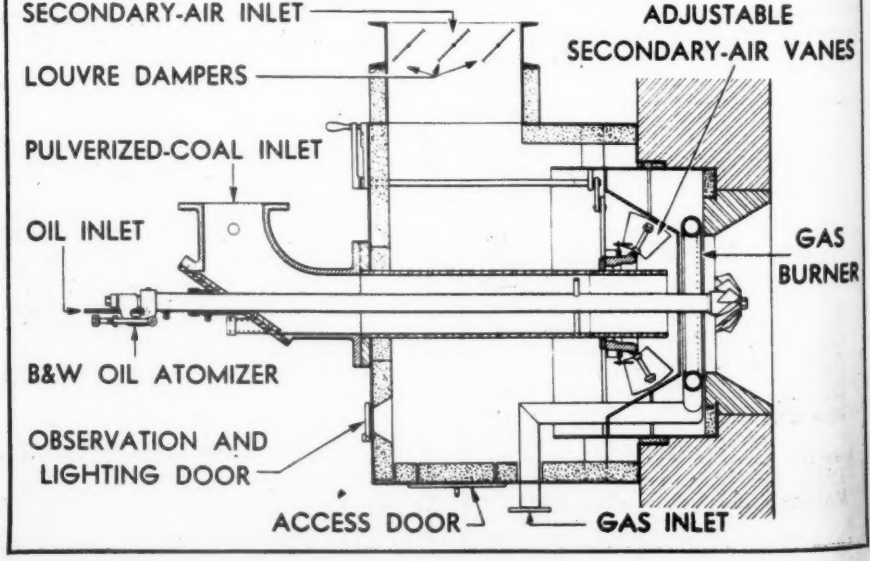
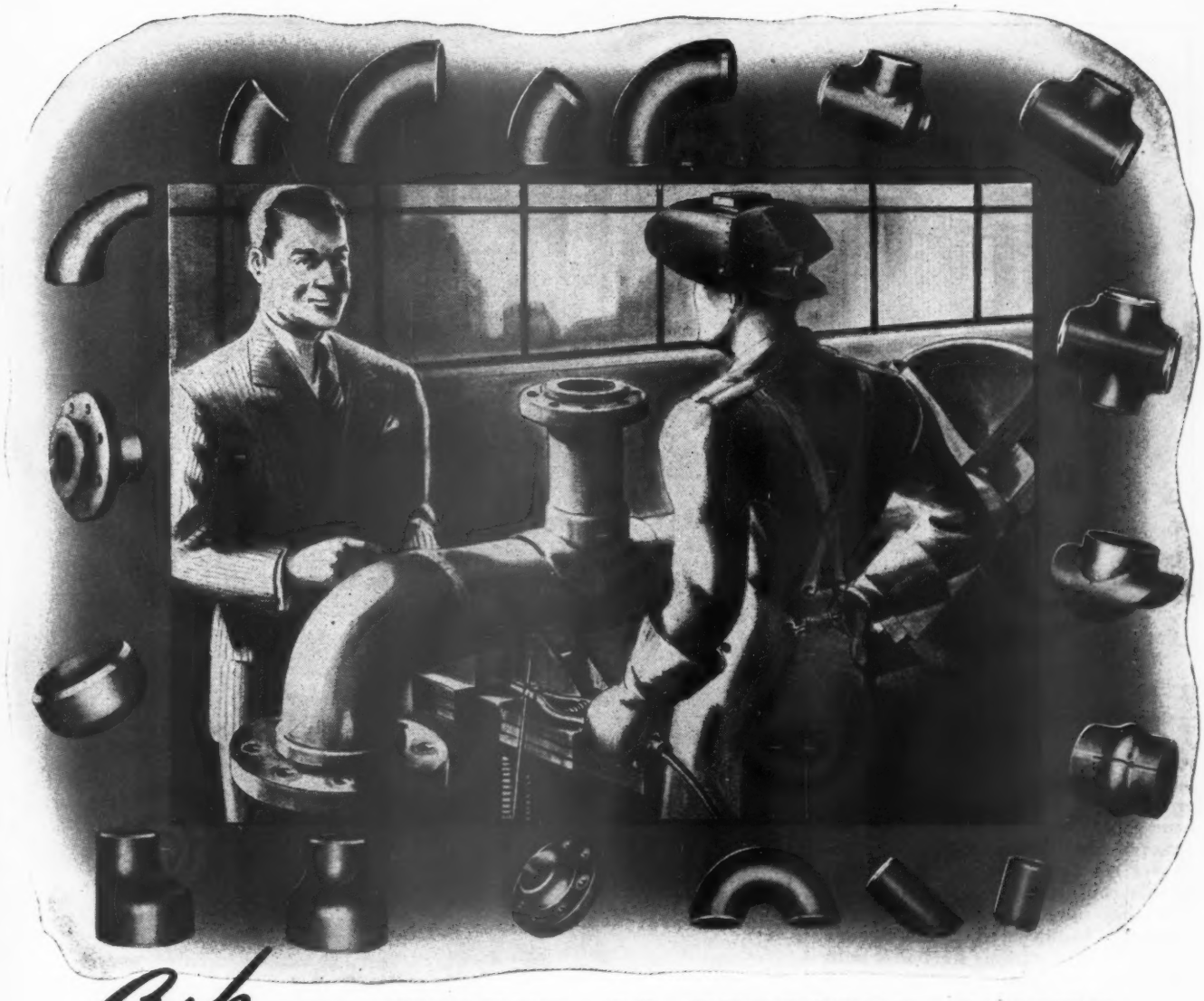


Fig. 4. Pulverized petroleum coke burner that also handles liquid or gaseous fuels.





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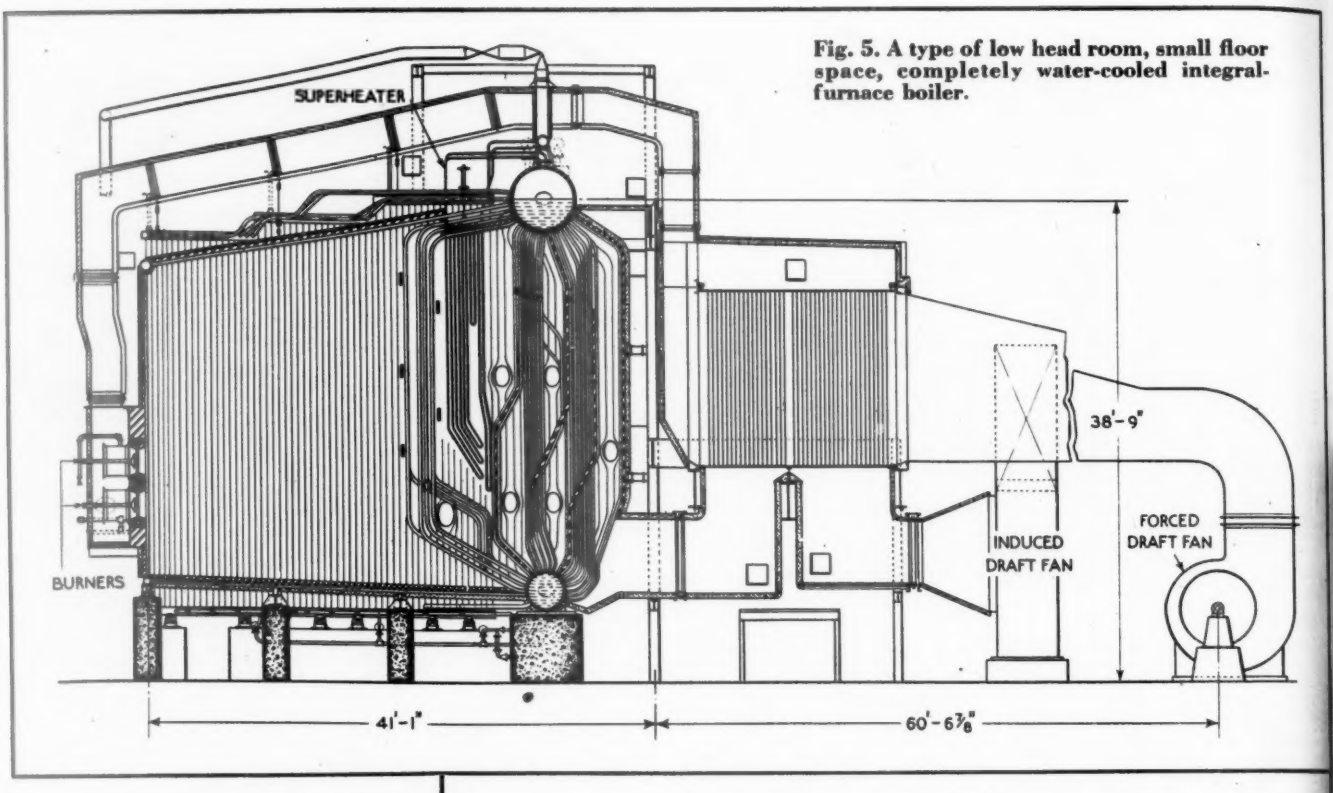

Fig. 5. A type of low head room, small floor space, completely water-cooled integral-furnace boiler.

volumes of high pressure steam do a better job of removing these deposits but, even then, it may be necessary to use hand lances or wash the surfaces. Analyses of these deposits show as much as 65 per cent sulphate and other water soluble constituents. This solubility in water has solved the problem of their removal in instances where other conditions permitted washing the boiler units with water. Analyses of several samples of slag are shown in Table 3.

The deposits on the furnace wall tubes are serious enough in that they affect the heat absorbing capacity of the furnace wall tubes because of the insulating effect of this deposit. The deposits on the boiler and superheater tubes are even more serious, because they can build up to a point where the gas passages are seriously reduced in area and the draft loss increases to such an extent that the capacity of the unit is reduced.

The deposits on air heater and economizer surfaces result in serious corrosion of the metal in those areas where the metal temperature is below the dew point for these sulphur-laden gases. The deposits themselves are corrosive in nature and accelerate further corrosion; therefore, it is important that they be removed. All air heaters should be arranged with an air bypass or recirculating duct so that the air temperature through the airheater is increased, thereby raising the metal temperature, which is about midway between air and gas temperature.

The dampers in a bypass duct permit a portion of the air to bypass the air heater so that the lesser quantity of air passing through the air heater will be at a higher temperature. The dampers in a recirculating duct arrangement permit some of the hot air from the air heater to mix with the incoming air, thereby rais-

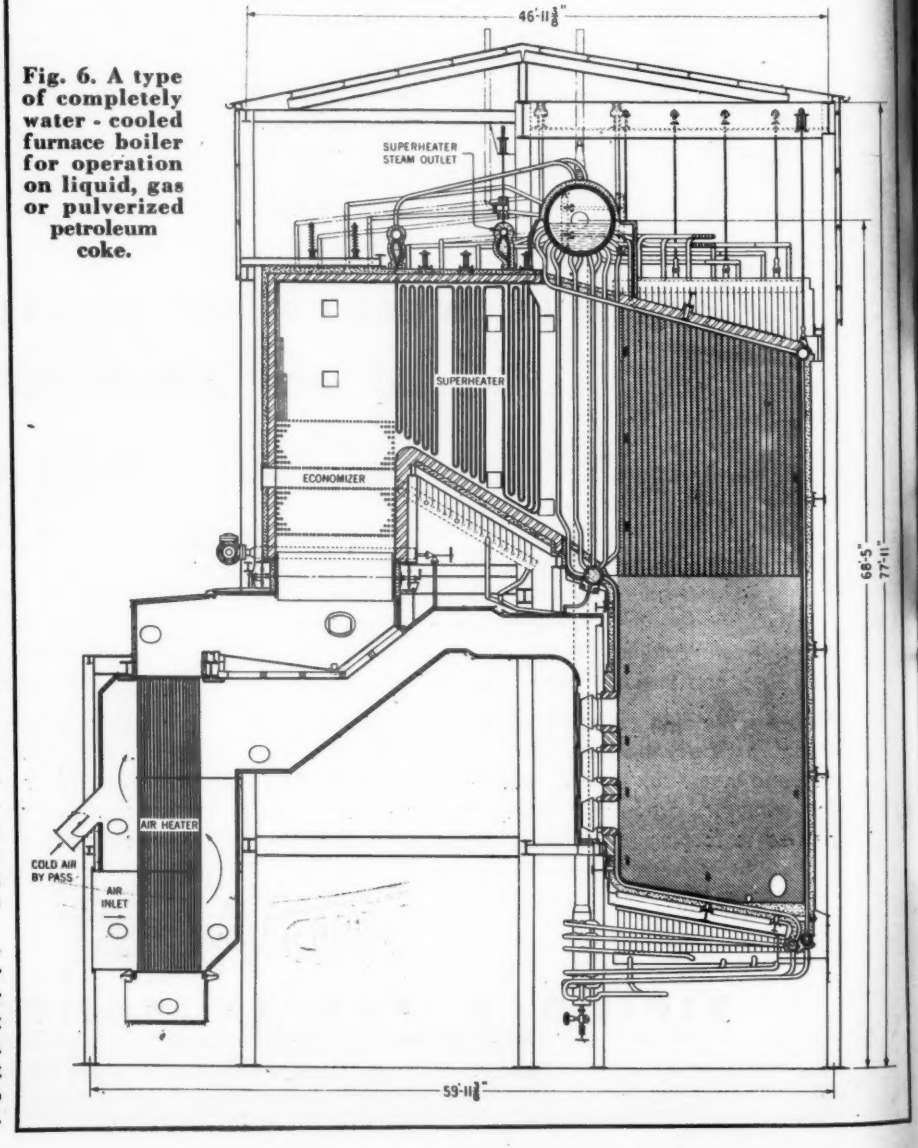

Fig. 6. A type of completely water-cooled furnace boiler for operation on liquid, gas or pulverized petroleum coke.

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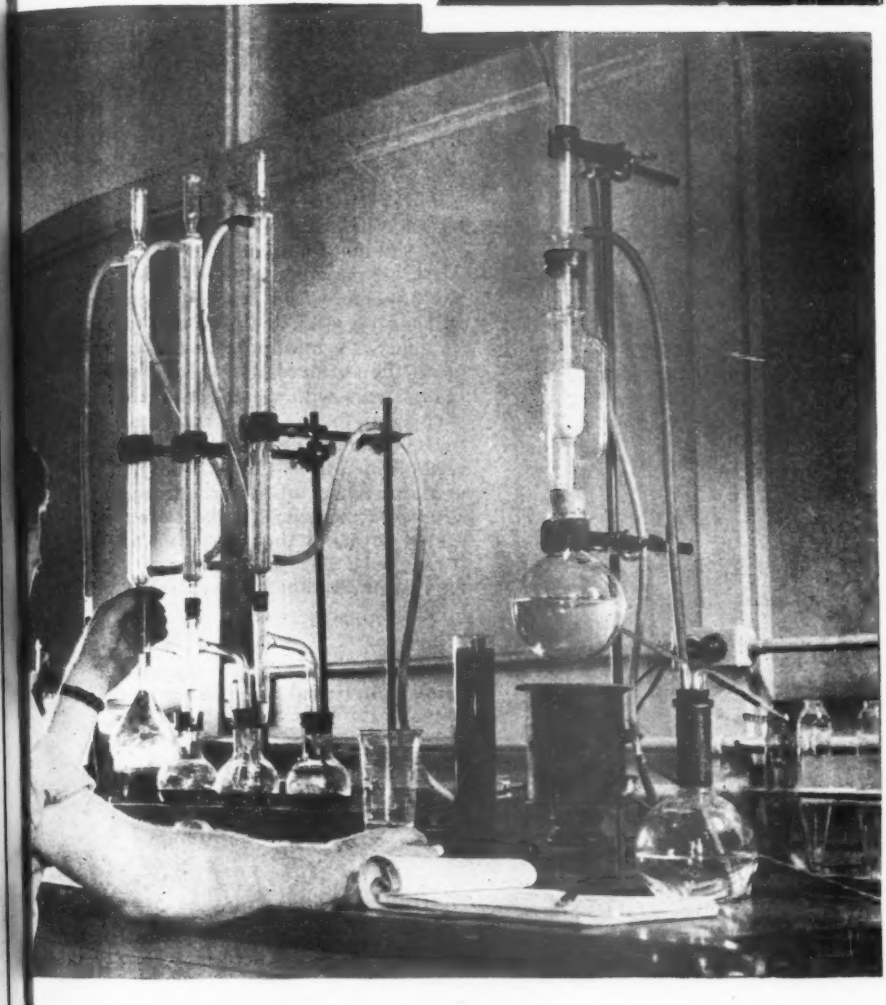

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ing the temperature of the air entering the air heater. With these arrangements it is possible to avoid metal temperatures that are too low for certain high sulphur fuels especially at the lower ratings. As a matter of fact, these dampers could be automatically controlled, operating from thermocouples attached to the air heater metal in the critical areas.

In economizers, the metal temperature follows the water temperature very closely and, therefore, the only way to increase the metal temperature is to raise the temperature of the water entering the economizer. This is impractical in most cases and, therefore, economizers should not be used when fuels are contaminated with more than 2 per cent sulphur unless the water temperature entering the economizer can be high enough so that the metal temperature does not fall below the dew point for sulphur laden gases.

● **Scale or sludge failures.** On the water side of the unit, the principal item of maintenance could be tube failures caused by scale or sludge accumulations on the inner surface of tubes. Most refineries use steam for process and require large quantities of makeup water. Generally this makeup water is none too attractive as boiler feedwater and requires thorough treatment to make it suitable for boilers. To the writer's knowledge, one refinery takes its water from a culvert that serves as a sewer.

Generally speaking, refineries have, and make good use of, feedwater treatment, but occasionally this treatment may lapse or the conditions might change temporarily so that scale forms on the tubes. This scale acts as an insulating layer on the inside of the tubes with the result that the tube metal temperature is elevated sufficiently to cause tube failure. In past years, the entire tube would have to be renewed but, with present day welding technique, the outage time for tube replacement is reduced considerably by butting-out the failed section of a tube and welding in a new section. This technique is illustrated in Fig. 7.

● **Scale removal.** Temporary upsets in feedwater treatment, resulting in scale formation, need not necessarily result in tube failure, if the scale is removed in time. Turbine tube cleaners are still being used effectively to remove scale from tubes. The outage time for such scale removal can be cut down considerably by a method of acid cleaning that is being used more and more these days. Under the competent supervision of chemists, a commercial chemical company will analyze scale and prescribe the proper acid and inhibitor, and arrange to clean the surfaces, supplying their own tank trucks with pumps and all necessary equipment. Under normal conditions, a boiler unit can be thoroughly acid cleaned in less than 24 hr.

Maintenance of superheaters can be kept at a minimum if the boiler is operated to avoid the carryover of water from the boiler into the superheaters. Such water would be evaporated in the

TABLE 3
Slag analysis

Fuel	Creek slop	Petroleum coke	Petroleum coke	Petroleum coke	Acid sludge	Fuel oil
Slag sample removed from	Boiler tubes in first gas pass	Furnace wall tubes	Superheater tubes	Primary furnace floor		Superheater tubes
Silica, SiO_2	19.8	67.7	11.6	19.1	11.7	3.0
Iron and alum oxides, R_2O_3	20.3	17.4	9.0	32.8	24.7	12.9
Calcium oxide, CaO	1.5	4.1	2.5	4.4	1.0	
Calcium sulphate, $CaSO_4$					3.7	7.8
Magnesium oxide, MgO	2.3	1.6	2.2	8.5	4.5	
Magnesium sulphate, $MgSO_4$					0.7	8.3
Phosphate as P_2O_5	0.6					
Sulphate, SO_3	25.5	7.2				
Sulphur, Na_2SO_4			53.1		42.2	65.3
Chloride, Cl	0.3					
Sodium oxide, Na_2O	29.7				4.3	
Titanium oxide, TiO_2		0.5	0.1	0.1		
Vanadium oxide, V_2O_5		1.5		8.8		
Vanadium as $2Na_2OV_2O_5$			20.0			
Chromium, Cr_2O_3			0.6	7.7	0.7	
Nickel, NiO			7.5	20.0		
Initial deformation	1810°F.	2040°F.		2600°F.		
Softening temperature	1840°F.	2180°F.		Above 2960°F.		
Fluid temperature	1880°F.	2810°F.		Above 2960°F.		

Fig. 7. Method of butting out failed tube section and welding in a new one.

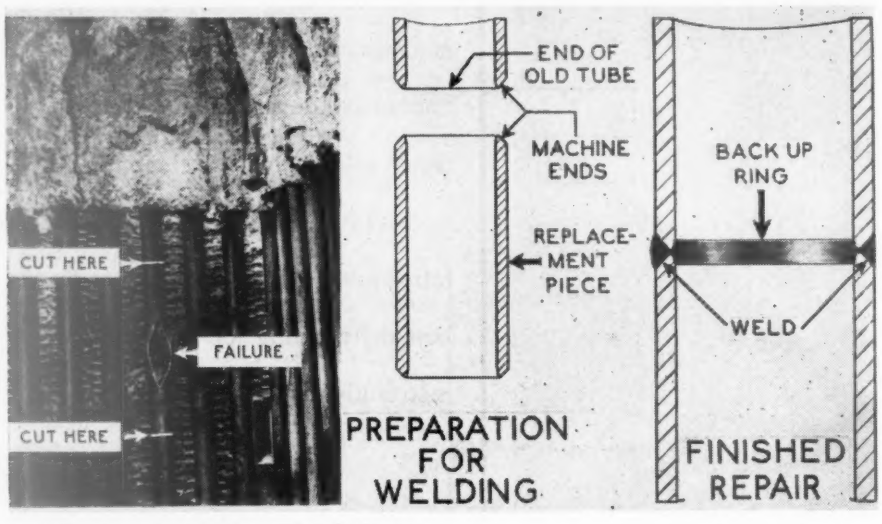
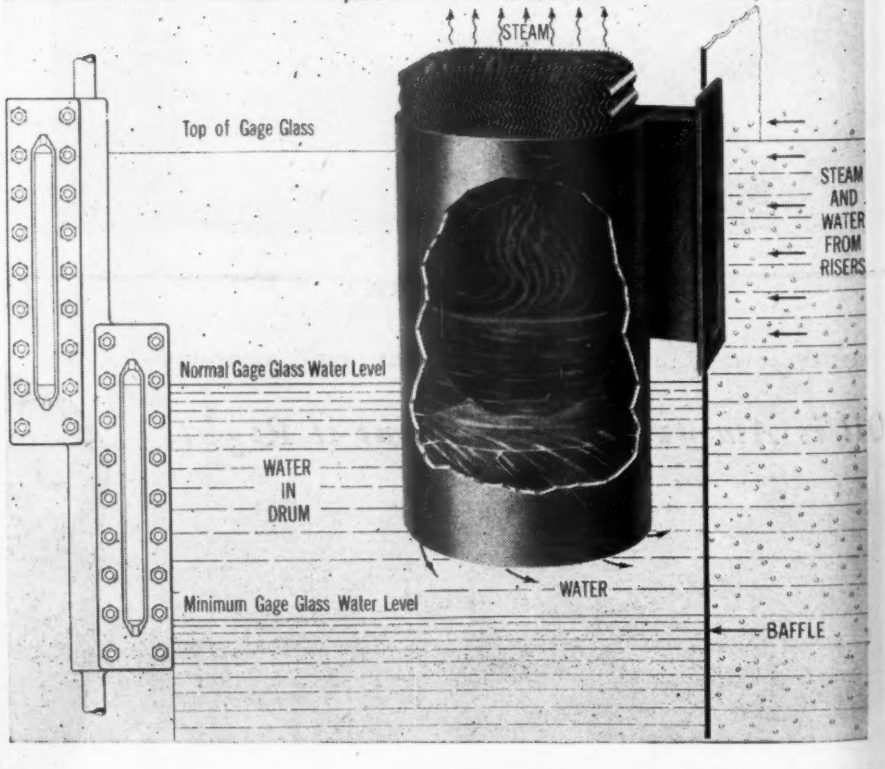
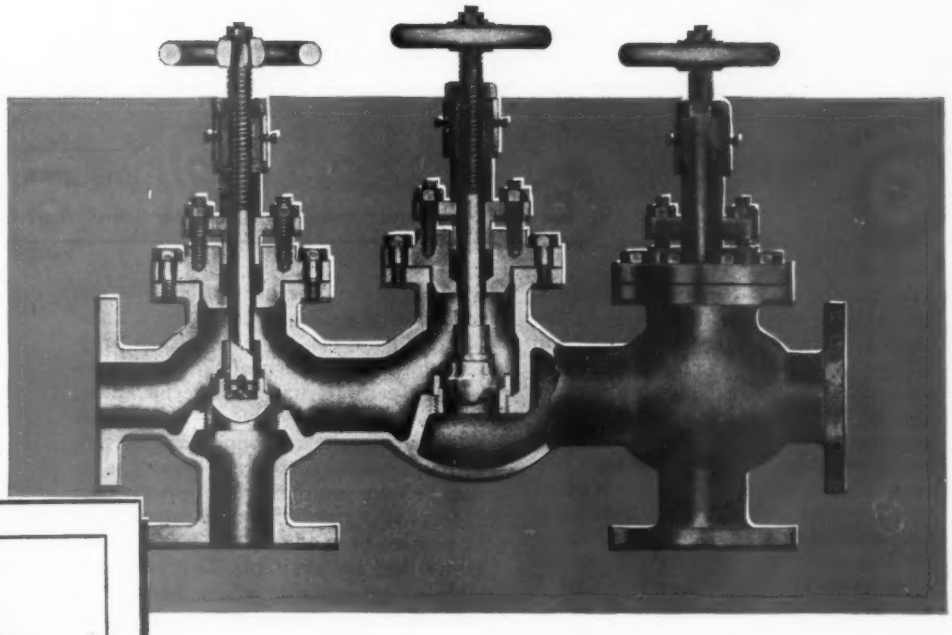


Fig. 8. Cyclone type separator using centrifugal force to separate water from steam.



NEW BY-PASS MANIFOLD Simplifies Piping Designs



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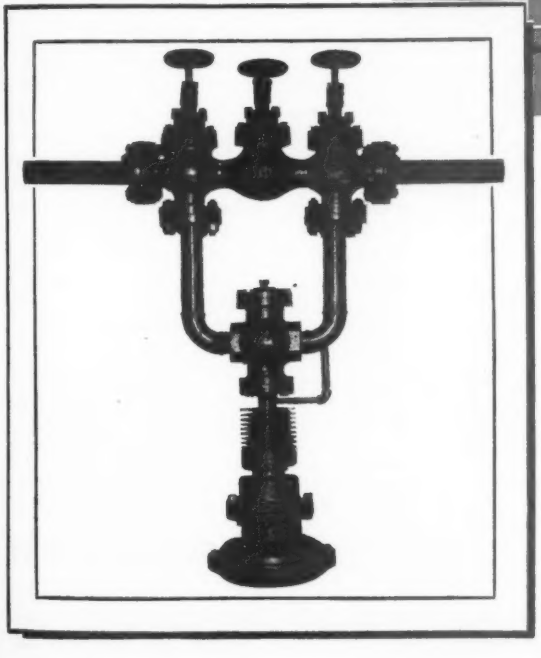

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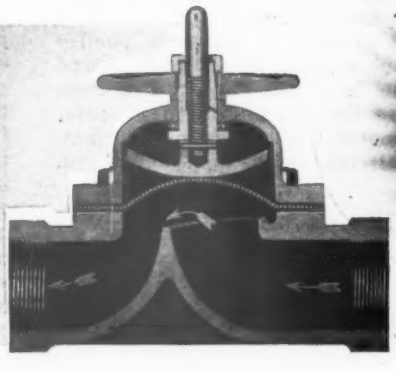

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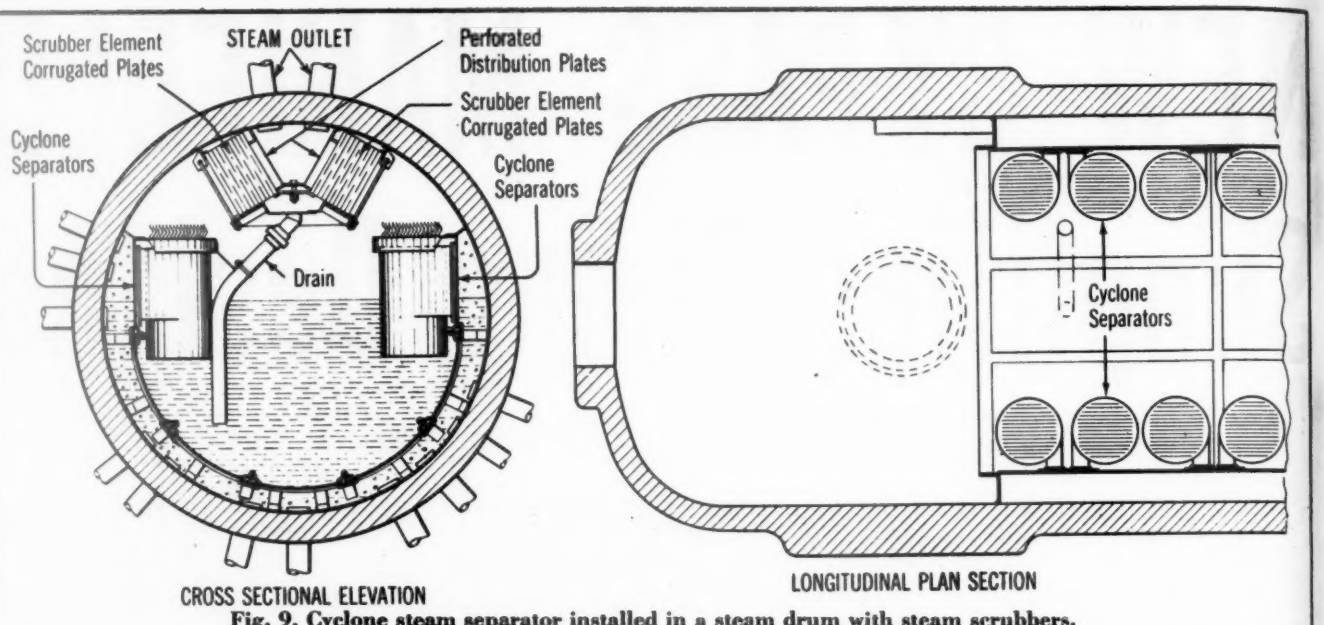

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● **Other maintenance sources.** Other sources of maintenance on superheaters are tube seat and handhole leakage, warping of the superheater elements, and oxidizing of supports and spacers. Some of these items can be minimized by proper care of the superheater during starting up periods, particularly by taking sufficient time to start up a boiler so that the superheater, which has no flow through it until steam is generated, does not become overheated. Supports and spacers to maintain tube alignment can, of course, be made of the better grade alloys that are available. If it is impossible to get suitable alloys because of priorities, very frequently an adequate repair can be made with a poured refractory baffle as a spacer or support.

Maintenance of the economizer may be required by tube seat or hand hole leakage resulting from sudden differences in temperature between the water and the pressure parts. Economizers are also subject to corrosion both internally and externally. The external corrosion has been mentioned in previous paragraphs. On the internal side, any entrained oxygen in the feedwater will corrode the inside of the tubes and it is surprising how little oxygen will cause severe corrosion. The feedwater should be thoroughly deaerated before it enters the economizer, either in an open heater with a large vent with feedwater heated to the boiling point or through specially designed deaerating heater. As a general rule the oxygen content in the feedwater should preferably be zero and certainly not higher than 0.02 cc. per liter.

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P 936.

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W. F. SCHAPHORST

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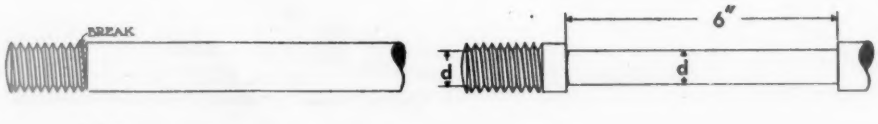

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By **L. R. MERRYMAN**

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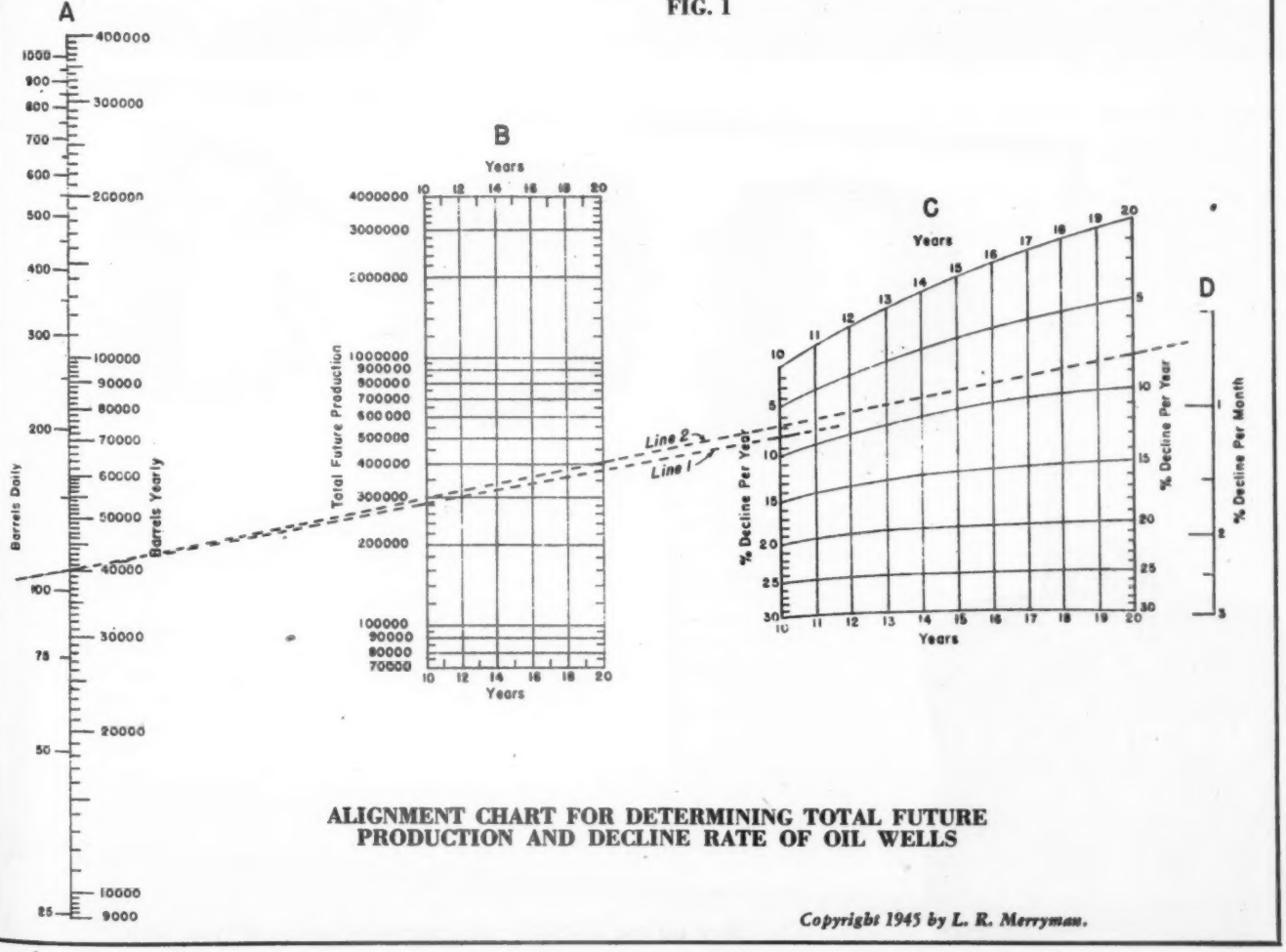
Practical application of the chart and examples of use are shown below:

● **Case No. 1.** A volumetric analysis of the reserves has been made and it is estimated that a certain property will ultimately produce approximately 500,000 bbl. of commercial oil. It is desirable to know how much of the oil will be produced during 10-year and 20-year periods. The property is currently producing at the rate of 40,150 bbl. annually or 110 bbl. per day. It is assumed that the property will decline at the rate of 8 per cent per year.

(Continued on Page 154)

FIG. 1



ALIGNMENT CHART FOR DETERMINING TOTAL FUTURE PRODUCTION AND DECLINE RATE OF OIL WELLS

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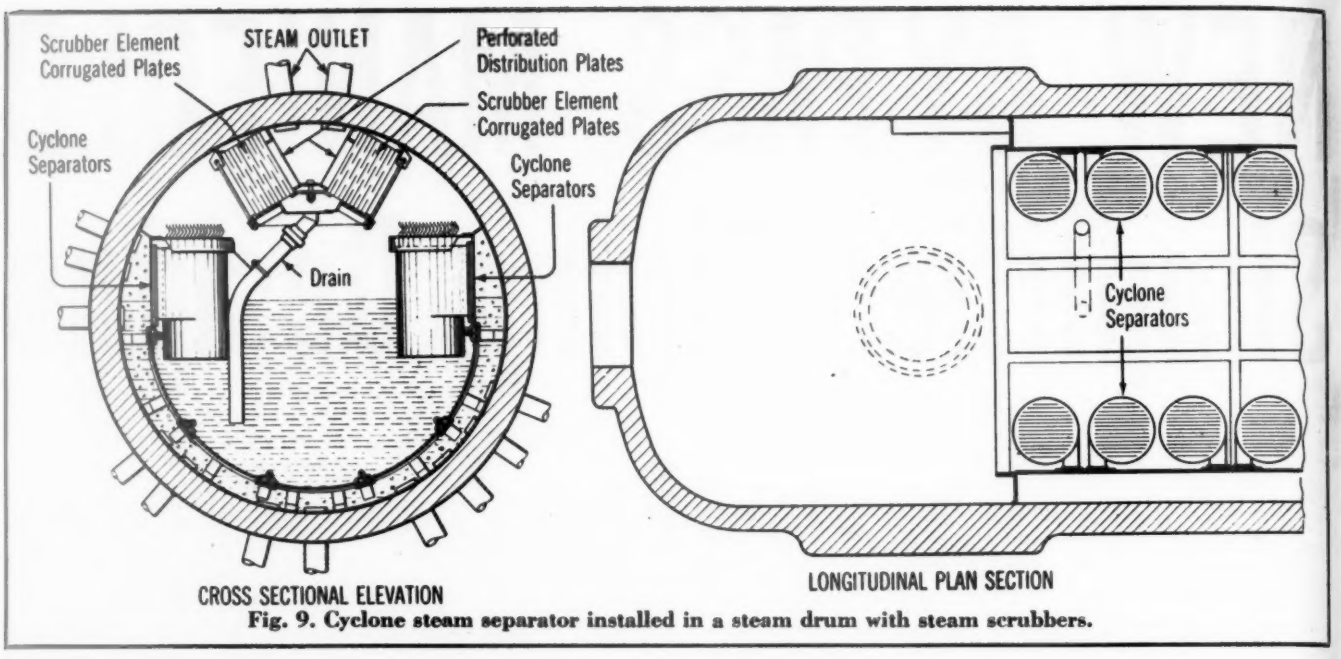

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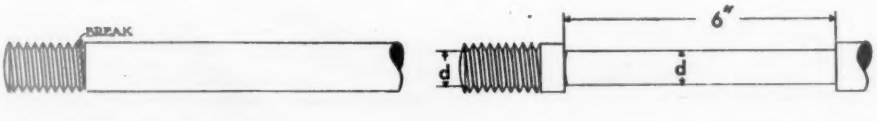

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(Continued on Page 154)

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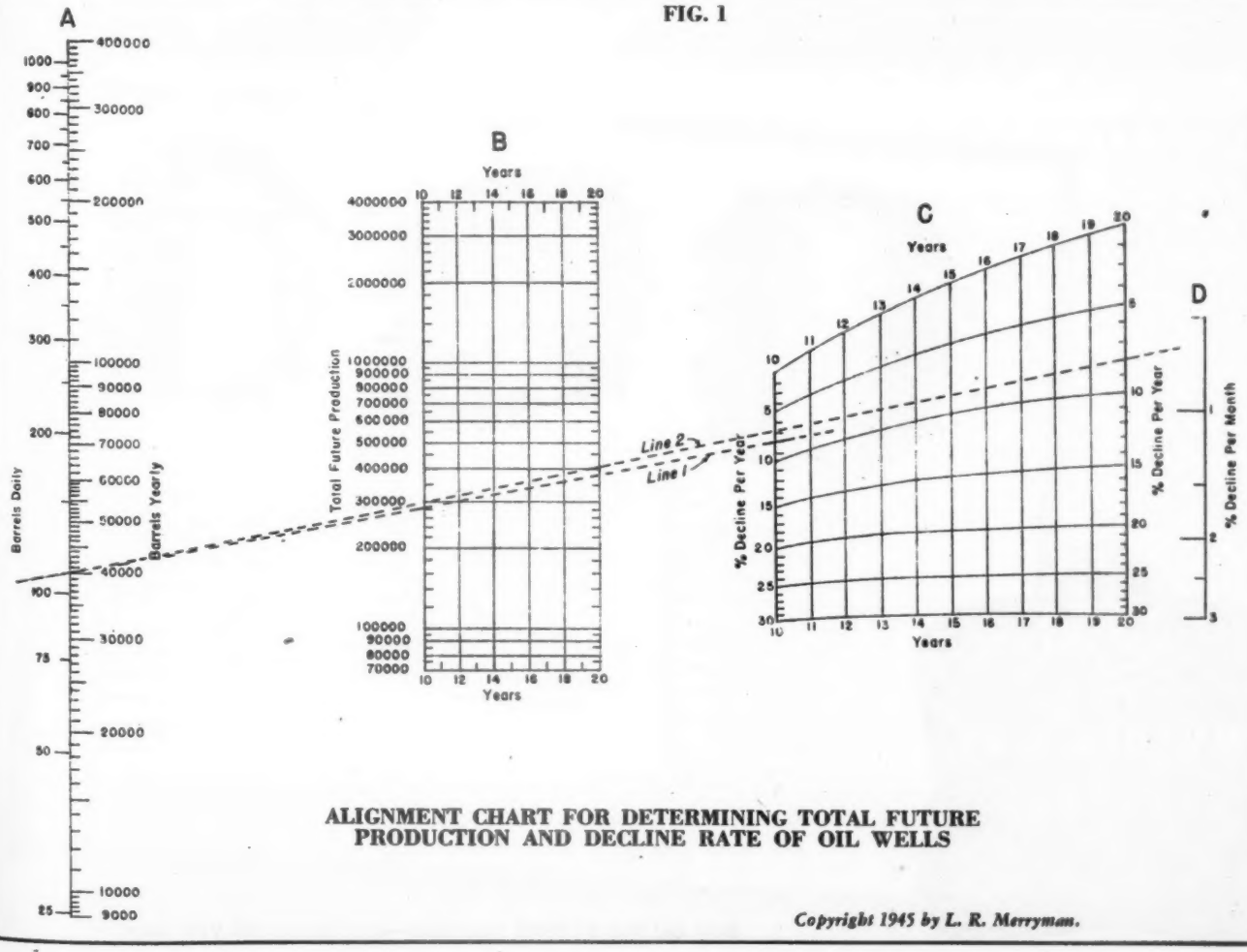

ALIGNMENT CHART FOR DETERMINING TOTAL FUTURE PRODUCTION AND DECLINE RATE OF OIL WELLS

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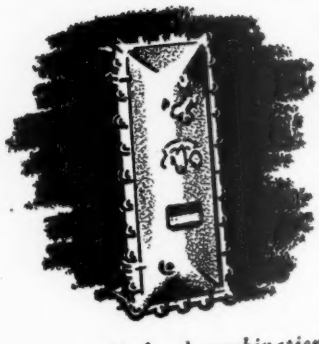
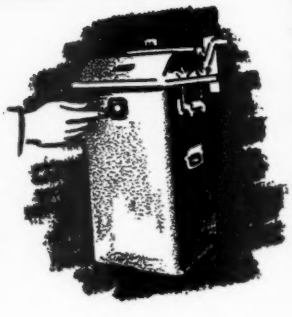
THE LOW-COST WAY TO OUTWIT

SEVERAL of 16 G-E totally enclosed motors for Class I, Group D, locations driving pumps in a Texas condensate-recovery and re-pressuring plant.



Air-break combination starter for Class I, Group D, locations. Combines air circuit breaker and magnetic starter in one compact unit. Made of cast, high-strength alloy, and having accurately ground, tight-fitting flanges, these starters can withstand internal explosions and prevent the escape of hot gases.

Push-button station for corrosive and hazardous-gas locations. All contacts operate under oil. Entire unit is enclosed in a cast-iron case which is specially finished to withstand acid fumes, alkali dust, or exposed outdoor service.



Oil-immersed combination starter for Class I, Group D, locations. All contacts are at least six inches under oil. Easy-to-read indicator provides safety check on oil level. Extra-tough exterior finish provides extra protection from corrosion caused by chemical fumes or exposure to weather.

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●In your plans to re-align your refinery for competitive, peacetime production, have you considered how you can cut the cost of supplying drive power in hazardous areas? Full utilization of G-E explosion-proof motors and control, wisely applied with the aid of G-E engineers, may well mean savings that will look big when competition gets keen.

It will mean savings in engineering time and construction costs, because you eliminate the need for building special vaults to isolate motors and control. It will mean less maintenance, because you avoid cumbersome remote drives, and because totally enclosed electric equipment is inherently less subject to trouble. It will mean lower insurance costs, because your plant will have the best in electrical safety.

General Electric has the most complete line of motors and control specially designed for refinery service. You'll also find expert assistance in selecting motors and control which best combine economy and safety on your jobs. G-E engineers specializing in refinery applications are at your service. Call on them now. *General Electric Company, Schenectady 5, N. Y.*

* * *

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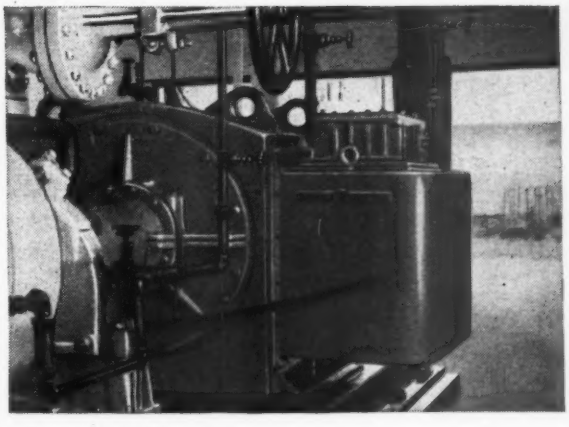

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like the one shown above, have proved particularly useful in hazardous-area applications calling for motors of 400 hp or more. These motors are furnished with special enclosures and auxiliary equipment which maintain an atmosphere of carbon dioxide, under slight pressure, in the motor. The positive pressure prevents entry of hazardous gas, although the enclosure is sufficiently tight to prevent excessive leakage of CO_2. Make-up requirements are very small.

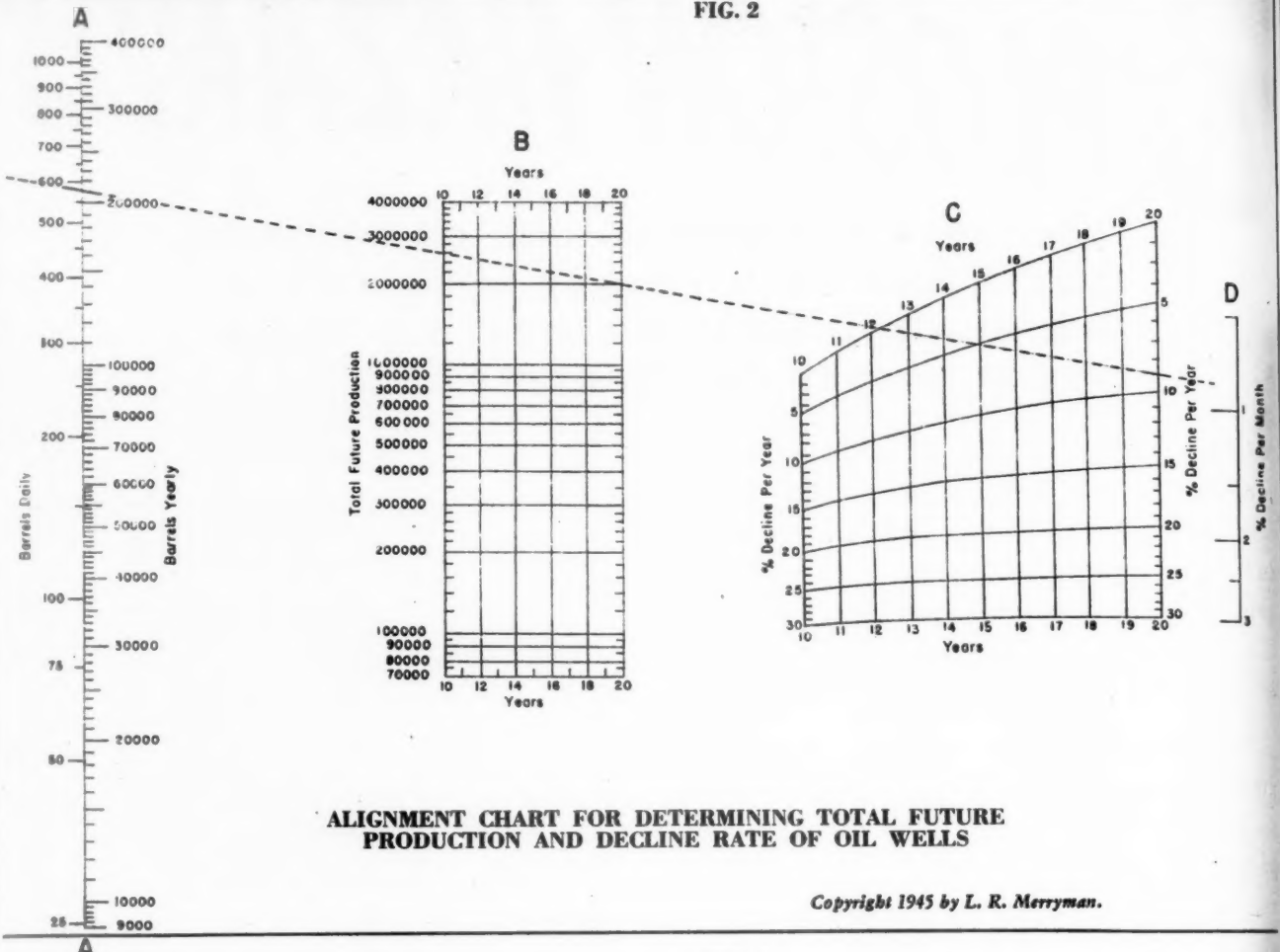
The G-E motor shown here, rated 1000 hp at 3000 rpm, drives a hot-oil charging pump in a California refinery.

GENERAL ELECTRIC

654-38-152

(Continued from Page 151)

FIG. 2



ALIGNMENT CHART FOR DETERMINING TOTAL FUTURE PRODUCTION AND DECLINE RATE OF OIL WELLS

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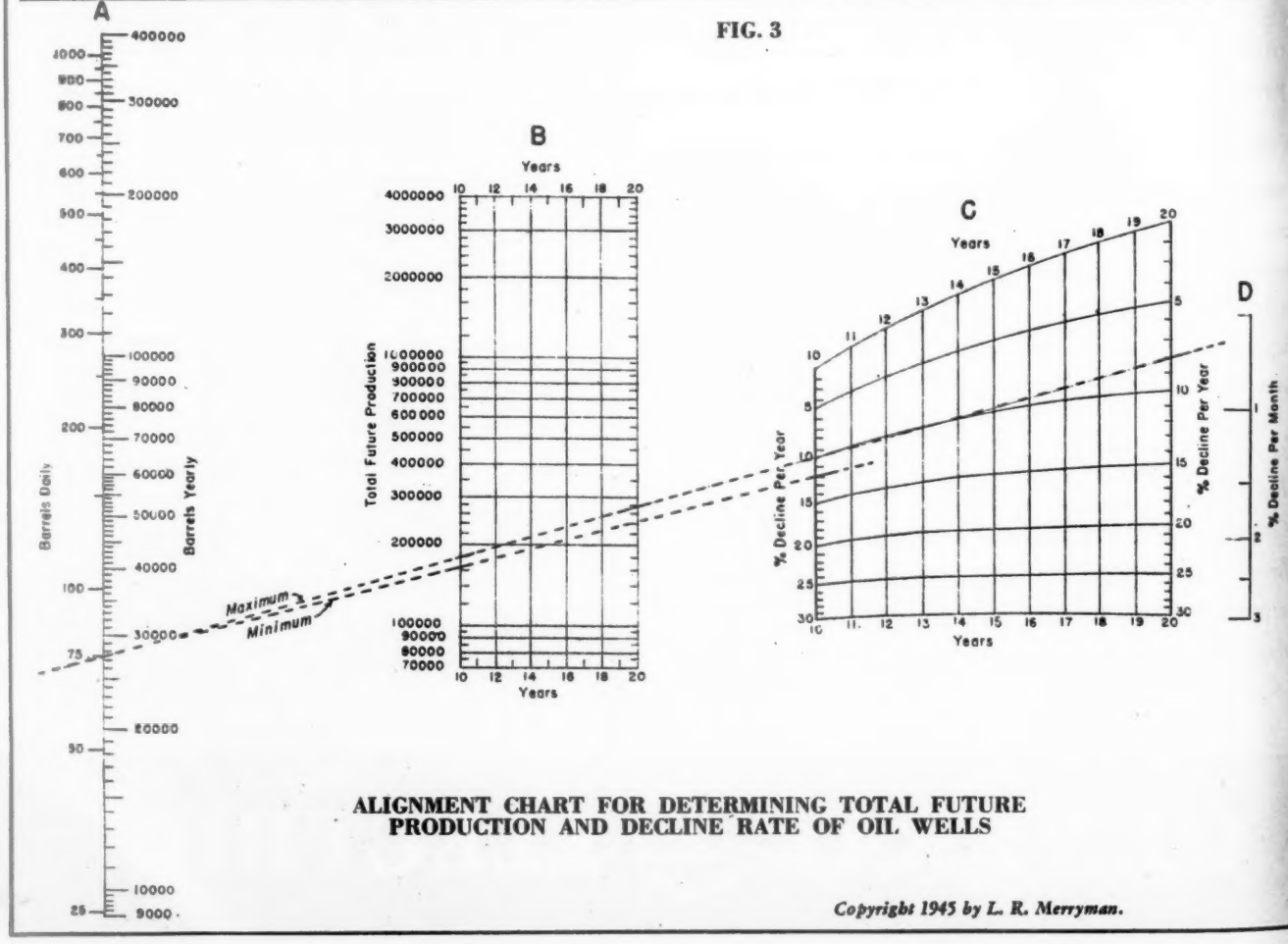
FIG. 3



ALIGNMENT CHART FOR DETERMINING TOTAL FUTURE PRODUCTION AND DECLINE RATE OF OIL WELLS

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Here is CORROSION RESISTANT ALLOY VALVE DATA
that will help you Maintain Design and Production Schedules

● No matter how corrosive or abrasive your substance, there is a combination of alloys that *must* be used for efficient gate valve operation. To help you, this data is published in the interest of maintained production schedules and lower operation costs. It is available to design and maintenance engineers upon request.

General Guide to Materials for Various Services

Service	Major Parts	Trim	Pipe and Tubing
Acetic Acid	Ni-Resist, Copper	Special Bronzes, Stainless Monel, High Nickel Chromium	Copper, Monel, Aluminum
Acetone	Brass, Copper	Special Bronzes, Stainless	Copper
Air	Iron, Steel, Brass	" "	Iron, Steel, Brass, Copper
Alcohol	Iron, Steel, Brass, Copper	" "	" " "
Ammonia	Iron, Steel, Ni-Resist, Brass, Bronze, Stainless, Monel	" " "	" " "
Aniline Dyes	I...	Monel	
Beer	S...	Stainless, Monel	" "
Brine			
Calcium Chloride			
Carbon Tetrachloride			
Carbonic Acid			
Calcium			

MATERIAL SPECIFICATIONS (METALS AND ALLOYS)

Darling Designation	Nearest A.S.T.M. Specifications	A.S.T.M. Specifications	Type or Name of Metal or Alloy	Form in Which Used	PHYSICAL PROPERTIES: Tensile Strength P.S.I.	Yield Point P.S.I.	Elong. in 2" %	Reduc. of Area %	Brinell Hardness	USES
Daraloy 437		B59-39 Grade A	Special Aluminum-Bronze	Castings	80,000	45,000	18		90	Valve stems, yoke stem nuts, disc facing, pressure castings, hydrant parts, seat rings, etc.
Al.		B26-37	Aluminum	Castings	20,000	7,000	5			Valve parts for certain corrosive services.
		B89-40		Bar Stock	35,000	9,000	16	40		Valve stems for certain corrosive services.
...lar			Bolting Material, Regular	Headed Bolts or Studs	60,000	45,000	18	45		Ordinary service
		A96-39	Bolting Material,	Bolt Stud	125,000	105,000	16	50		High temperature and high pressure service.

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WHEN MADE OVER IRON BODY, U-BOLT, BRONZE OR SPECIALLOY PATTERNS

USE OF CHART

Example—Assume that a 6-inch gate valve, made of Monel and suitable for 150 lbs. cold service pressure is needed. Monel is in Alloy Group C. Under 6-inch valves you find that a Group C valve to meet your needs can be obtained in the 125 lb. Steam, Iron Body pattern, the 150 lb. Steam, Bronze pattern, and the Specialloy pattern.
NOTE—Pressures shown in chart are the same for all sizes of valves in same shaded area.

ALLOY GROUP

A—Darvaliron, Darling 3, 146, and 180 Alloys.
B—Darling 137 Alloy Body and Bonnet, and 437 Alloy Discs.
C—Monel, Darling 96, 97, 302, 410 and 437 Alloys.
D—Aluminum.

Pattern	Regular Rating	Page No.	Alloy Group	SIZE OF VALVE, in Inches: ¼	⅜	½	¾	1	1¼	1½	2	2½	3	4	5	6	8	10	12
				Alloy Rated Service Pressures in lbs. per sq. in. at 100° F.															
IRON BODY GATE VALVES	25 lb. Steam		A B C D											50 125 125 40		50 125 125 40	50 125 125* 40	50 125 125* 40	—
	125 lb. Steam		A B C D											150 200 200 100		150 200 200* 100	150 200 200* 100	—	—
	175 lb. O-W-G		A B C D											175 250 250 175		175 250 250 175	175 250 250* 175	—	—
	200 lb. O-W-G		A B C D											200 250 250 200		200 250 250 200	200 250 250* 200	—	—

TRADE DARLING MARK

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WILLIAMSPORT, PA.

The solution is shown on Fig. 1 and it is determined as follows: A straight edge is placed at 40,150 on scale A and at 8 per cent on scale C at the 10-year line. The answer, 285,000 bbl., is then read on scale B at the 10-year line, as shown by Line 1. Line 2 on the same figure shows the production that would be produced in 20 years. The procedure is the same except that the 20-year lines are used on the B and C scales. To obtain the 20-year value a straight edge is placed at 40,150 on scale A and at 8 per cent per year on the 20-year line on scale C. The answer, 410,000 bbl., is read at 20 years on scale B.

A problem of this type is frequently asked the engineer or geologist, after he has made an estimate of the reserves on a property. The answers found by use of the accompanying chart are only approximate, because it is impossible to interpolate when the figures are of such magnitude as shown on scale B. If a complete forecast of production and a valuation are required it is necessary to compute the annual production with a calculator or by use of a chart similar to the one described in the January issue.

● **Case No. 2.** An estimate of the commercial oil available on a given property has been made. The total future production is determined to be 2,000,000 bbl. The present production is 575 bbl. per day or 210,000 bbl. per year. It is desired to know at what rate the property will decline if the oil is produced in 20 years. The solution is illustrated on Fig. 2 and is determined as follows: A straight edge is placed at 210,000 on scale A and at 2,000,000 on the 20-year line on scale B. The answer, 9 per cent per year, is read on the 20-year line on scale C. This answer is only approximate and if close work is being done the decline rate would have to be tested by actual computation.

While the rate of decline is usually beyond the control of the operator, a problem of the above type must often be solved for valuation purposes. The decline rate, as determined from the chart, is relatively simple, but the solution for the rate of decline from equation

$$s = a\,\frac{(1-r^n)}{1-r}$$

can only be made by a laborious cut and try method, unless, of course, a value for the last term is assumed.

● **Case No. 3.** An estimate of the future production from a property has been made by volumetric means. The calculations show that there are 400,000 bbl. of commercial oil on the property. Wells producing from similar horizons are known to decline from 8 to 12 per cent per year. The property is currently producing at the rate of 75 bbl. per day, or 27,375 bbl. annually. A rough check on the computations can be made as described, in the following manner: The solution is illustrated on Fig. 3. A straight edge is placed at 75 bbl. per day on scale A and at 12 per cent on the 10-year line on scale C. This shows that the production in the first 10 years will be 165,000 bbl. (10-year line on scale B). The maximum decline rate is used for the shortest period considered, to determine the absolute minimum production. The production for the first 20 years is then determined as follows: A straight edge is placed at 75 bbl. per day on scale A and at 8 per cent on the 20-year line. This shows that the property will produce only 280,000 bbl. in 20 years.

The minimum decline rate is used for the longer period to determine the maximum that could be expected to be produced from the property. The test above gives a range of values that would appear reasonable. In the example chosen, as the estimate does not fall within the limits found by the chart, it would indicate that the estimate is too high, or that the property is not being produced at capacity. The chart, if used in this manner, may be a useful tool when it is desired to check estimates made by the volumetric method.

Scale D is used with scale C to convert per cent decline per month to per cent decline per year.

In addition to the accompanying chart, which is designed to find the decline rate when the total production is estimated and the number of years is assumed, the author has designed a chart that will solve for the number of years required to produce a given amount of oil when the decline rate is assumed. The chart designed to solve for the number of years is a companion chart to the one described in this issue and it will be presented in a later issue. ★★★

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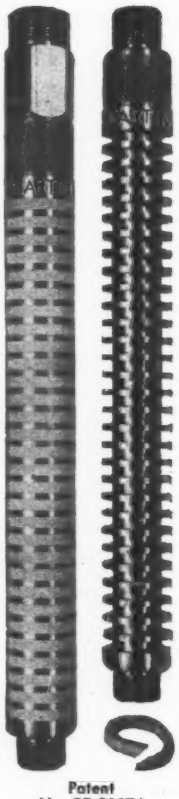

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HOW TO OBTAIN GREATER INCREASES FROM USE OF ACID

By **C. E. CLASON,** *Superintendent Acidizing*
Halliburton Oil Well Cementing Company

EXCLUSIVE THE ACTION of an acid on calcium and magnesium carbonates, of which limestones and dolomites are composed, depends upon actual contact. In making this contact, the oil in the existing channels and crevices of the formation is pushed ahead or may form an emulsion with a plain acid solution, depending on the natural characteristics of the oil. At 100°F., a 15 per cent acid solution has a viscosity of about 0.68 centipoise, and oil of 40° API about 4.5 centipoises. Each is not very viscous as we normally think of a viscous fluid, but the difference is in favor of the oil resisting displacement, and so a higher pressure is necessary to overcome this resistance in placing the acid.

A greater retarding feature is the relative ability of oil and acid to adhere to the formation. The surface tension of a liquid has a direct bearing on its ability to adhere to a solid. The greater the surface tension of a liquid the less tendency it has to adhere to a solid. At 100°F. the surface tension of acid is about 50 dynes per cm., whereas oil of 38° API is about 27, and indicates the greater tendency of the oil to adhere to the formation and its resistance to removal by the acid. Acid at this temperature also can be reduced to 27 dynes per cm. by use of an additive, thus increasing its ability to displace the oil and permit better contact of the acid with the formation.

It is assumed that plain acid finally spends itself because of its contact with and solvent action on the formation during its travel. Acid placed in a well should be entirely spent on the formation and the reaction greatest and at a definite rate at the point desired, enlarging the crevices in such a way that the greatest flow of oil will result.

Some oils will emulsify with plain acid. This emulsification affects the treatment and results in an excessive volume of cut oil following a treatment. Emulsification may cause a thick viscous mixture to form, which seriously impedes the entrance of acid into the crevices. It is now known that in the past high pressures used in treating frequently were the result of a refractory emulsion having formed, which retarded penetration of the acid and its solvent action on the formation. The emulsion prevented good contact of the acid with the formation. To forestall trouble of this kind the oil should be tested for its tendency to form an emulsion with the acid. If found to be necessary, penetration of the acid and its contact with the formation can be aided by the addition of chemicals, the cost of which is small compared with the better results that can be obtained. This is highly important in some fields, and good results will depend upon it.

The first step in acidizing any well consists in working close to the bore of the hole to remove mud, etc., and to restore as far as possible the natural permeability of the formation. Small clean-up and wash shots accomplish this and, in some cases, do all that is necessary to make a well produce its allowable. This has been very well demonstrated recently in the West Edmond field of Oklahoma, treating opposite pay sections with a usual 1000 gal. of acid through gun-perforated casing. This procedure should be accepted as logical and correct even though some operators do not fully subscribe to it. This article will now deal with additional stages that reach out and increase permeability away from the bore of the well or from gun-shot courses.

A discussion of factors that will result in better yields and require less shut down time of wells.

A well is drilled with drill pipe and bits. A permeable vertical opening is made in the formation to allow flow of oil or gas. Gun-perforating is also a mechanical aid, the numerous horizontal bullet holes increasing the avenues of flow. How far these bullet openings extend in a given well may not be definitely known, but gun-perforating is a substantial aid in completing a well and in segregating pay zones.

Acid can be considered as a chemical drill that adds to recovery of oil by opening up flow channels in a horizontal direction. Sometimes new channels are formed by the solvent action of the acid.

The amount of increase in oil or gas production will depend upon the oil or gas content and the existing pressure. If the formation, taking into consideration the formation pressure and the effective porosity or pore space holding available oil, is permeable enough to begin with or perhaps after the initial cleaning out to allow maximum flow, enlarging the crevices will not increase the flow of oil or gas. Although such a condition may be found in new wells, it is met with mostly in old wells when they are retreated, especially if the field is well along toward depletion.

When acid is injected into a formation and an increase in production results regardless of slow or fast injection, it indicates that the acid has removed some limestone. Experience of this kind prompts such questions as: Can the action of the acid be improved upon in any way? What is the action under pressure and how can the channels be enlarged so that the greatest delivery of oil or gas will result? Can the shape of channels be changed by acid in a way that will allow greater flow as the formation fluids approach the bore of the well? The theoretical aspects of these questions have been discussed in detail in a previous article;[1] only their practical aspects will be briefly reviewed here.

In drilling a well the diameter of the hole is limited by the size of the bit, but acid is a flexible chemical drill. Increasing channel sizes or removing the limestone from them depends upon the quantity of acid, its rate of flow and time of contact. Acid does not react instantaneously, especially under pressure; neither can any volume of acid be placed in a formation in a few seconds. In acid treatment there must be some procedure followed that involves pumping speed and its control. If the acid could be placed immediately so that contact with the formation were made simultaneously at all points to be treated, channel enlargements would be uniform. In practice it is not possible to place the acid in that way. Too slow a placement of the acid allows greater enlargement at the initial point of contact near the bore of the well, and as the acid is pushed ahead it becomes spent at the end of its travel and removes no limestone. Somewhere between these two points lies a mark to aim

[1] "A New Conception of Acidizing," by C. E. Clason. *The Petroleum Engineer*, May, June, and July, 1943.

Contact time, min.	Limestone		Average		Dolomite	
	Reaction, per cent	Flow capacity eff., per cent	Reaction, per cent	Flow capacity eff., per cent	Reaction, per cent	Flow capacity eff., per cent
5	68	44	40	16	12	1.5
10	76	58	56.5	32	33	11
15	82	67	69	48	52	27
20	87	76	79	62.5	70	49
25	90	81	88	77	82	67
30	95	90	93.5	87	92.5	85
35	97	93.5	96.0	91	95.5	90
40	98.5	97	98	95	97	93.5
45	100	100	99	97	98	95
50	100	100	100	100	99	97

at for any acid treatment or stage of treatment.

Nearly all limestone or dolomite formations have a number of fine cracks and crevices in large or small amount. These are in effect permeable streaks, or flow channels, that connect with the bore of the well. The acid placed in the well can be visualized as traveling outward from the bore as from a hub toward the rim of a thick wheel. The combined area of these channels at the rim of the wheel is much greater than at the hub, or near the bore of the well. In other words, the flow capacity of the channels becomes more restricted as the bore of the well is approached. Consequently there is a great drop in pressure during the last few feet of travel toward the well, and a zone of turbulence is set up as the oil and gas crowd into the converging area of the well bore. Obviously, any relief that can be given in this zone to permit easier passage of oil and gas will result in a greater volume of flow into the well.

Crevices or channels penetrated by the bit can have other horizontal connecting crevices at distances from the well bore, and the system as a whole may be compared to many rivers with their tributaries all leading to a common sea—the bore of the well. A river grows larger as it nears its mouth; therefore, to deliver more fluid, crevices and channels in like manner should be larger near the bore of the well.

Immediately acid comes in contact with limestone it begins to react, and as it travels it continues to react until it becomes entirely spent. It removes less and less limestone as it penetrates the formation and approaches the end of its journey. Obviously, if a volume of acid is pumped into a well at the correct rate and is barely displaced from the bore of the well, two things will occur. First, the head end of the acid will just reach neutrality, or be spent, and second, the acid at the tail end will have to react. More unspent acid passes through crevices near the bore of the well than at succeeding points outward. The result is that all channels are from 14 to 29 per cent larger near the bore than they were originally, depending upon the speed of reaction between the acid and limestone. Enlargement will gradually diminish outward as far as the acid has traveled, until a point is reached where no enlargement has occurred.

If the rate of reaction with various limestones and dolomites under pressure is known, a time-rate curve can be plotted showing the amount of acid used or spent at various periods during travel. Lessening the travel time either by fast pumping or displacement, makes for more uniform removal, and in extreme cases can cause greater enlargement at points quite distant from the well bore. The rate of travel outward can be further speeded up by using a vast amount of flushing oil or water. When the rate is such that less than 50 per cent of the acid has reacted, greater enlargement of channels may occur at points of treatment farthest from the well bore and result in a bottle-neck of the flow channels nearer the well bore.

This wrong practice can affect results, for, according to the permeability formula of Darcy, the rate of flow of fluids in a crevice is proportional to the square of the increase in diameter or size. Thus if a crevice were doubled in size the rate of flow would be increased four times. Yet if acid is injected so that it reacts uniformly during its full limit of travel, the enlargement of crevices will be only from 14 to 29 per cent, an average of 21 per cent, or about a 46 per cent increase in flowing capacity. It is assumed that if such a result were obtained, the increase would be within a distance of not more than 5 ft. from the bore of the well. This would indicate a formation the uniformity of whose permeability and porosity was similar to that of sand. When an increase of several hundred per cent is obtained, it can be assumed that the acid penetrated a greater distance through crevices and that the radial flow capacity of the system was accordingly increased to a much greater distance.

If, however, a good increase were obtained with a pumping rate far exceeding the theoretical, even better results are possible. An average limestone or dolomite will react with acid under pressure in 50 minutes. The rate of reaction, not being a straight line function, would use up 56.5 per cent of the acid present in about 10 minutes, and the channels near the bore would be widened only 56.5 per cent as much as they would have been at the proper pumping speed of 50

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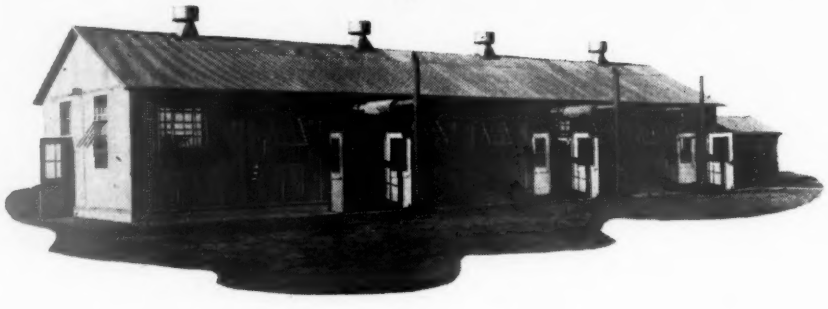

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minutes. Widening the channels 56.5 per cent will permit only 31.9 per cent as much flow as is possible when the time of reaction is 50 minutes. Several instances have been reported from the field in which the acid left the well bore in 8 minutes. Only 40 per cent reaction was obtained in that particular formation, resulting in an increase in flowing capacity of only 16 per cent instead of a possible 100 per cent. Contact periods of 15 minutes have been common that resulted in 47 per cent of the possible increase in production. In the foregoing examples discussed acidizing was only 16, 31.9, and 47 per cent efficient.

The per cent reaction at various contact times in limestone and dolomite are shown in the accompanying table. The per cent reaction serves as an index of limestone or dolomite removal, hence increases in channel size, and were taken from points on a time-rate of reaction curve. The increase in flowing capacity is expressed in per cent efficiency. The figures in the table under limestone refer to a very fast-acting limestone, such as the Kansas City in Kansas, soft Dundee in Michigan, and some Mississippian and Devonian limestones. The figures under average seem to correspond to rates for gas-producing formations in the Hugoton and Finney County gas fields. The figures under dolomite refer to the Permian in West Texas. Note how the efficiency decreases when the contact time is less than 30 minutes. Obviously, cutting the contact time too short gives very poor results compared with those obtained when the contact time is 50 minutes. Data in the table apply to a single operation or stage treatment on a well. It is true that several stages will gradually widen crevices near the well bore, but if they are all performed in the same manner, the same reasoning for time of contact per stage holds. There is a distinct possibility that a good many wells still have a chance for greater production due to past practice of using either too slow or too fast pumping speeds.

Many formations break down upon contact with the acid allowing the acid to pass into the formation at high speed. This indicates that great permeability has been established and the object of acidizing accomplished. The flow can then be regulated by use of valves or by slower pumping.

Occasionally a wildcat well with only a slight show of oil, indicating low permeability, will be acidized. A small clean-up acid treatment will sometimes reveal that the natural permeability of formation has been impaired by mudding off. In some cable tool wells in a soft formation closing of the crevice openings by the action of the drill may hold back production. If after a clean-up treatment the well still will not take acid under high pressure at a sufficient rate of speed, the flow of acid should be reversed and withdrawn from the hole, and another batch of fresh acid tried. If the penetration of the acid is still too slow—it should not exceed 1½ or 2 hours—the formation probably lacks sufficient permeability and may be classed as a dry hole.

There is everything to gain and very little to lose by paying attention to the pumping speed or the time it takes the acid to penetrate the formation.

Many operators have spent money needlessly on pumping great amounts of water or oil to insure forcing the acid at high speed into the formation. Fast pumping in such cases shortens the life of equipment—an important consideration during war times. Much time has been wasted due to the erroneous use of weak acid wash solutions in gas wells. A well-planned program, carefully carried out, will result in shorter periods of shutdown and less off-the-line time for gas wells. ★★★

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INVASION-TYPE MILITARY PIPE LINES

By **FRANK H. LOVE**
Managing Editor

EXCLUSIVE APPROXIMATELY 10,000 miles of invasion-type military pipe lines are now in use in all theaters of war. More than 50,000,000 gallons, or 141,000 tons, of gasoline are being delivered to fighting forces overseas each day, and of this volume 70 per cent is being moved by pipe line. To do this job without pipe lines would require the daily use of about 25,000 tank trucks each having 2000-gallon capacity.

Used first by the United Nations in the African campaign the military pipe line, or what is popularly termed "portable" pipe line, was designed to supply fuel to tanks and automotive equipment of an advancing army, as well as to advance air fields and supply depots. It served well in that campaign and has served well since. This pipe line system, which can be quickly installed and easily repaired in event of damage by bombing or artillery fire, has proved invaluable.

During the early stages of the military operations in France, when Allied armies were making such rapid advances, General Somervell gave voice to one reason for the astounding successes when he said: "Our troops on the continent are getting at least a million gallons of gasoline a day." To the military pipe line, which from D-Day on carried gasoline and oil close up to the front lines, goes the credit for this "million gallons of gasoline a day." Two hundred and fifty thousand men on a beachhead use up about 100,000 tons of petroleum, oil, and lubricants a month. When an invasion breaks out of a beachhead and mechanized equipment begins to cover more ground, a proportionately greater amount of these supplies is necessary.

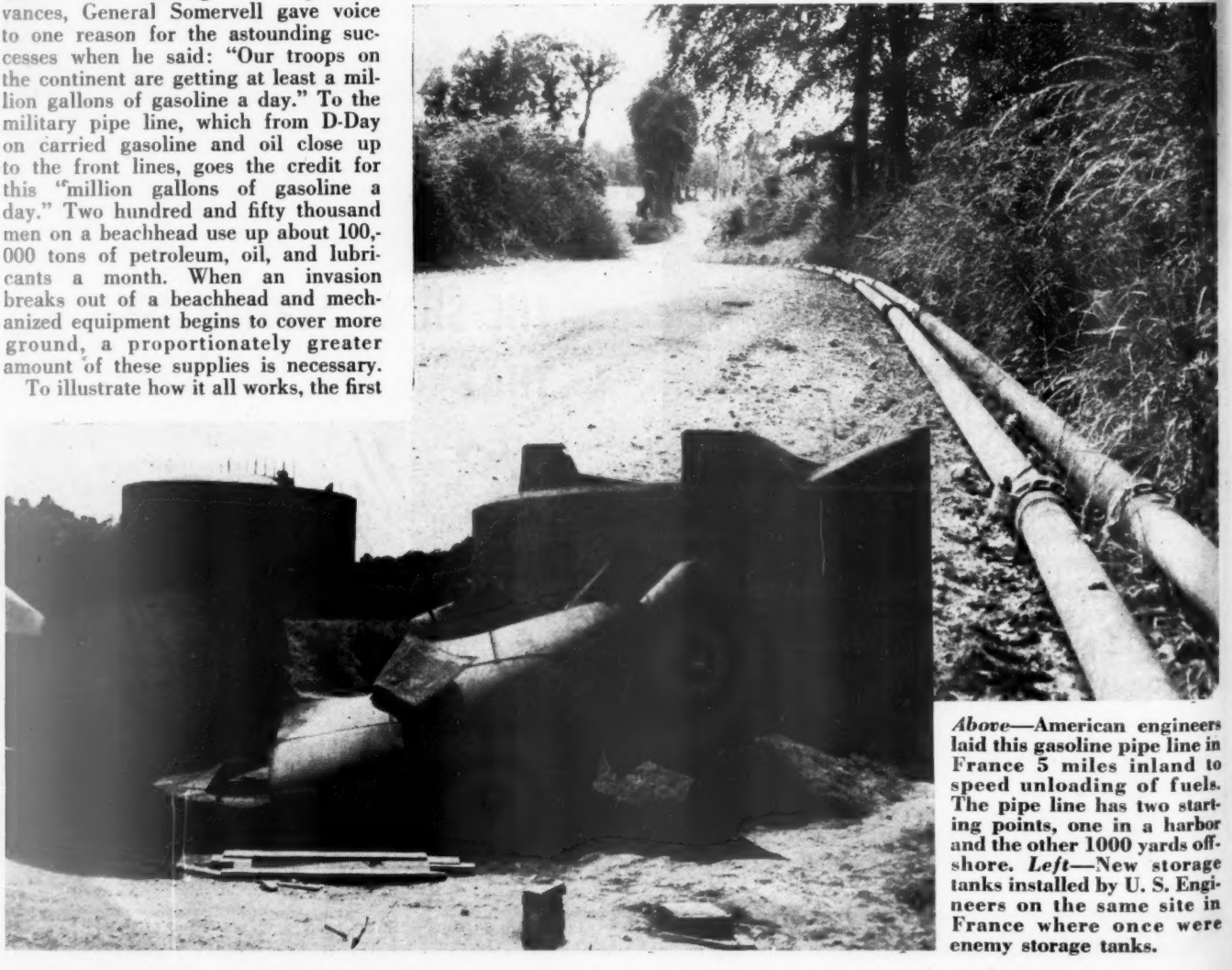
To illustrate how it all works, the first wave of motorized equipment is fueled on the beaches from 55-gallon drums. Meanwhile, U. S. Army Engineers are laying a pipe line from tankers offshore to storage tanks that are then being set up. These are either portable rubber tanks having a capacity of 3000 gal. each, or 10,000-bbl. steel tanks that are landed in sections and assembled within a day's time. With the beach storage tanks installed, the engineers begin laying a pipe line inland, in the wake of the armored columns.

These lines transport high octane aviation gasoline, lower grade gasoline for staff cars, tanks, jeeps, stoves, etc., and diesel fuel for bulldozers and certain types of tanks.

Early construction of pipe lines to captured airfields takes a great load off the port clearance, transport, and distributing services. In the matter of supplies, about 60 per cent of an air force's requirements is fuel. Unless pipe lines are provided a large volume of equipment must be imported to haul the gasoline. Each pipe line installed removes from the roads about 400 fuel trucks a day, thus clearing the way for other cargo needed up front.

The pipe line system has demonstrated itself to be more desirable than truck supply. Trucking, for one thing, requires ten times as much manpower as laying and maintaining a pipe line. In event of sabotage or a lucky bomb hit only a few lengths of pipe are damaged whereas a direct hit on a truck convoy is considerably more serious.

Although the pipe lines are "portable" and are constructed of light weight pipe, there is no limitation on the distance they can be laid. Late last fall a pipe line extending all the way from Calcutta up the Brahmaputra Valley through Assam and into North Burma was completed and went into immediate service supplying oil and gasoline for airplanes and motor vehicles at American installations in the North Burma-



***Above*—American engineers laid this gasoline pipe line in France 5 miles inland to speed unloading of fuels. The pipe line has two starting points, one in a harbor and the other 1000 yards offshore. *Left*—New storage tanks installed by U. S. Engineers on the same site in France where once were enemy storage tanks.**

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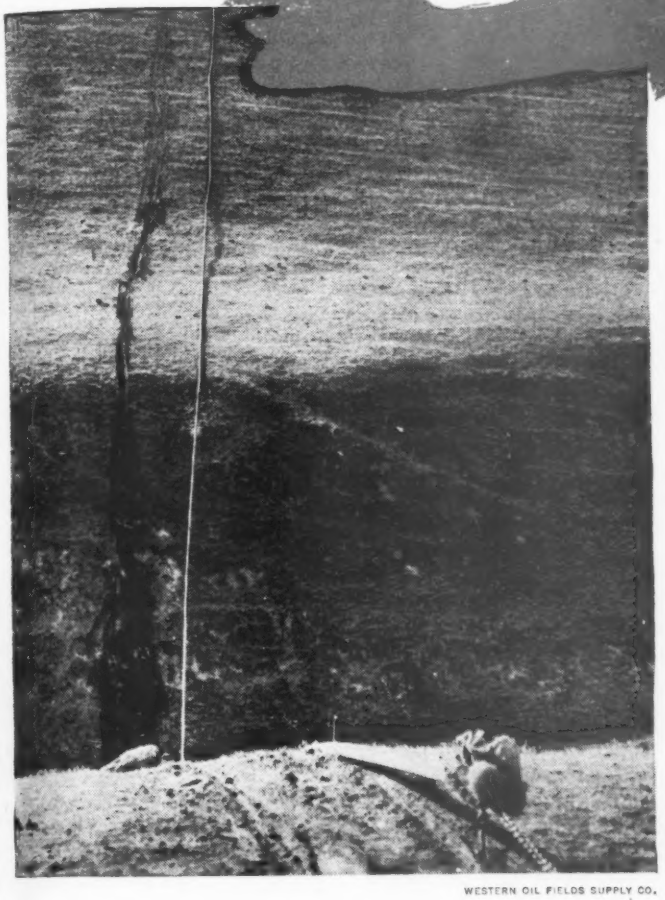

WESTERN OIL FIELDS SUPPLY CO.

OFFICIAL U. S. ARMY SIGNAL CORPS PHOTO

IN PEACE Here 50 sections of pipe joined by Victaulic Couplings are being hauled *in one piece* up and down hills and across ravines! Under such rugged conditions each coupling is subject to terrific strains of pull and sag. Yet not a single coupling gave way, in 15,000 feet of pipeline!

OR WAR! This is an Army pipeline spanning a river — more than a dozen pipe sections are joined by Victaulic Couplings. Not only can Victaulic Couplings stand up to the strain of continuous sag . . . but even the concussion of enemy bombs fail to disturb their tough grip.

THE two special features of built-in flexibility and mechanical lock make Victaulic Couplings specially suitable for tough jobs, in war or peace. The simplicity of their assembly gives Victaulic the extra advantage of speed, and low-cost installation. For full details of the famed Victaulic self-aligning pipe couplings and full-flow fittings write to: VICTAULIC COMPANY OF AMERICA, 30 Rockefeller Plaza, New York 20, N. Y. Other Victaulic offices—Victaulic Inc., 727 West 7th St., Los Angeles 14, California; Victaulic Co. of Canada, Ltd., 200 Bay St., Toronto, Ontario, Can.

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SELF-ALIGNING PIPE COUPLINGS AND FULL-FLOW FITTINGS

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War Bonds—a pipe line from you to him

OIL MINING MARINE MUNICIPAL INDUSTRIAL

Assam combat area. Extension of the line into the central Yunnan airfield area of China was begun immediately. Total length of this line is approximately 2000 miles—the longest single pipe line in the world not excepting the "Big Inch," which is 1388 miles long. This achievement is impressive and is considered to be the greatest pipe line construction feat in history. Although in the past many pipe lines have been laid under difficulties, there is no known instance on record when these difficulties were so numerous or so extensive. From Calcutta the line passes over a flat plain, then for many miles is under river waters, crosses the 4000-ft. passes of Naga and Patkai Hills, and traverses hundreds of miles of dense jungle.

The line was built by the Supply Construction Service headed by Brig. Gen. Thomas F. Farrell, former chief engineer of New York State. Directly in charge of line construction were two well known former United States pipe line men, Col. William C. Kinsolving of Beaumont, Texas, and Lt. Col. Birney K. Morse, Swarthmore, Pennsylvania. Colonel Kinsolving formerly was general manager of the Sun Pipe Line Company and assistant director of transportation of the Petroleum Administration for War. Lt. Col. Morse formerly was chief engineer and a director of the Susquehanna Pipe Line Company.

Construction of parts of the line was begun as early as December, 1943; however, major construction was started in March, 1944. Men in the construction units received a six weeks' training course in the United States during which they laid pipe lines under simulated battle conditions.

Fuels and oils enter the line at Calcutta from tankers. Products are from Middle Eastern and other refineries.

● **Design of line.** The design of invasion-type military pipe lines is based on the fundamental idea that pressures in a pipe line can be used to control flow in the line in a manner that, regardless of length, terrain, and other complications, it can be turned off at the delivery point like a garden hose, meanwhile functionally controlling all parts so that no excessive pressures are generated by stoppage, nor dangerous runaways or voids created by restarting. Automatic equipment so controls the line that flow of product can be stopped at any point without excessive pressures being built up, and immediately upon opening the valve at the point of stoppage flow will be resumed.

Individual stations that become inoperative reduce the capacity of the line about 30 per cent; however, capacity returns to normal immediately upon resumption of operation of the station. If put out of action, a station can be replaced with a new unit in a matter of 2 or 3 hours.

● **Pumping stations.** Pumping stations are mounted on 4-wheel trailers, each unit weighing about 16,000 lb. The pumps are duplex double-acting units and are driven through V-belts by gasoline engines.

Mounted on the trailer also is the control apparatus that operates the engine throttle and provides high pressure relief in case of shut down of the line. A part of the station equipment is a bypass stop lift check valve across which the pump operates and through which fluid bypasses the station when it is temporarily off the line for repairs or is shut down. The gasoline engine is equipped with a generator and storage battery to provide starting, and when necessary, lighting.

Each station has six automatic controls as follows:

1. A suction control that throttles the engine so that it runs just fast enough to pump the product as it is received.
2. A pressure throttle that slows the engine when a predetermined pressure is reached, usually about 650 lb.
3. A high pressure relief that relieves liquid from discharge to suction when the pressure exceeds 650 lb.
4. A second high suction relief opens from discharge to suction of the pump when the suction pressure increases to 400-450 lb. This prevents a station from

Members of a petroleum operating unit in France tighten joints of a ship-to-shore line for unloading petroleum from ships. In the background members of the unit heave to in order to lift a flexible header into place.

building excessive pressure on the previous station's discharge pressure and avoids trouble when a valve is closed downstream.

5. A high suction throttle that, in the above condition, slows the engine to idling speed.

6. A check valve that permits fluid to bypass a station when it is out of operation.

The purpose of these various controls is to make possible the stoppage of flow through the line at any point.

So long as product is withdrawn at the terminus of the line, the several stations will pump automatically. If product is not needed the end of the line is closed and flow ceases. When the end of the line is opened the pressure will decline all along the line back toward No. 1 station and each station will automatically resume pumping as needed.

Stations are pre-tuned to operate as they should, and relatively simple field engineering assures their functioning within these pre-set limits. When repairs are needed, extra stations are installed and the defective stations taken to a central depot for repairs. Upon completion of the repairs a "dummy" run is made and the station tuned up to operate automatically at predetermined pressure settings.

Normal station operation contemplates a discharge pressure of approximately 400 lb. while pumping 200 bbl. per hour. At this pressure and capacity the power required from the engine is about 39 hp. As the pressure increases to 625 lb., as it may under automatic control, the horsepower requirement increases to 60.

The control system designed for these units heretofore has not been used in connection with internal-combustion engines connected to piston pumps. The principles of control insofar as they apply to pipe lines, disregarding the types of pumps and engines, are, however, all in use on commercial lines, with the exception of the high suction bypass, which was specially designed to fit the needs of this particular system. It, together with the high suction throttle, is believed to be new in principle and unique in pipe line control.

● **Line construction.** The line itself is of spiral welded 4-in. and 6-in. pipe and the joints are connected by Victaulic couplings. These couplings require only a light wrench to install, and the pipe joints are aligned and the coupling placed and tightened by a two-man team. This type coupling is also used for other fittings such as valves, strainers, tees, ells, etc. The pipe is light in weight, being 4.5 to 4.8 lb. per ft. As it is often necessary to lay 20 to 30 miles of pipe a day this lightness of weight is an important factor. Despite its lightness, however, the pipe is safe for a maximum operating pressure of 650 lb.

Standard joints of pipe are 20 ft. long and weigh 90-100 lb. each. Some of the joints are fabricated to contain block valves, which are installed each mile or where breaks are likely to occur, such as at road and river crossings, in bad soil,

On the India-Burma-China pipe line Cpl. Leo J. DiMatteo, Boston, and Pvt. Albert Viano, Joliet, Illinois, carry a section of pipe through the jungle.

etc. These joints are of two types, those containing gate valves and those containing twin gate and check valves. The latter are used on upgrades to provide automatic protection against runback in case of a break or leak. In certain cases they also prevent accumulation of pressure through stations where automatic controls have functioned to bypass a station.

● **Safety practices.** Although military pipe lines necessarily are constructed and operated under highly hazardous conditions, nevertheless it is considered essential that personnel be instructed in safe practices just as though they were carrying on their duties under peacetime conditions. For this purpose a safe practice code has been prepared for study. The code is extremely complete and was prepared with the benefit of knowledge gained by the pipe line industry through long experience. Although detailed, it is pointed out in the introduction to the printed instructions that this safe practice code cannot possibly cover all situations that may arise in the course of construction and operation of military pipe lines. "Instructions cannot replace the necessity for being constantly alert to the presence of hazards and dangers inherent in all petroleum operations, and particularly to those encountered under military operations in combat areas. This code should, however, by calling attention to dangers and unsafe practices that have caused accidents, benefit the personnel charged with the construction and operation of pipe lines by suggesting practical ways of avoiding accidents." It is upon this basis that the code has been prepared, the intention being to set up no specific plan of operation but to point out important features of safety procedures that have proved successful and are typical of petroleum industry safety practices.

Invasion-type pipe lines were born of this war. When the war began the army was prepared to depend on the use of cans and drums for fuel supply. The engineers, however, soon had other ideas—they tried pipe lines. Their success is the principal reason that our armed forces are seldom short of fuel and oils for tanks, trucks, airplanes, and the other mechanized instruments of war.

★★★

Honors employes

Sunray Oil Corporation recently honored its long-time employes with the presentation of silver, gold, and diamond awards. Service emblems, presented annually by the company to employes completing 5, 10, and 15 years' service, were given to 21 men and 2 women in Oklahoma, Texas, Kansas, and New York. and 4 employes now in the armed services of their country.

Harry H. Mack, vice president and general production superintendent, presented in the Oklahoma City district a silver award to Hugh D. Blackburn; gold awards for 10 years' service to W. L. Mastin, T. E. Cunnius, and C. H. Eastham; diamond awards, signifying 15 years' continuous employment, to Frank Moore, C. F. Kuhn, G. H. Gamble, and E. P. Heath.

Those in the Allen production district receiving 5-year silver awards were R. A. Brooks and C. T. Henkins. Ten-year gold awards went to Victor T. McGowen. J. B. Davis, and W. E. Westbrook.

In Texas the only employe this year to receive a service award was Thornton E. Pryor of the Odessa production district, whose 10 years' service merited a gold awards went to Victor T. McGowen, Kansas, received a 5-year silver award.

Four employes of Sunray's refinery at Allen, Pontotoc County, have completed 10 years' employment and received emblems in gold from Floyd L. Martin, vice president in charge of refining. They were: Joseph H. Passmore, Edgar Dean, Carl F. Kile, and David M. McCormick.

F. B. Stinson, accounting department, Tulsa office, received from President C. H. Wright, a diamond emblem in recognition of completion of 15 years' employment. D. C. Kennedy, assistant purchasing agent, was given a gold award. Mrs. Gwyneth J. Davidson, of the legal department, was the first Sunray woman to receive a 15-year service award. To Miss Sibyl Wengle, assistant secretary, New York City, went a gold emblem, representing 10 years with the company.

Eligible for silver awards now on military leave are: Lt. David P. Johnston, Navy, A. E. Moeller CM 1/c, Lt. Edgar H. Parks, Marine Corps, and Pfc. T. A. Clote, Air Corps.

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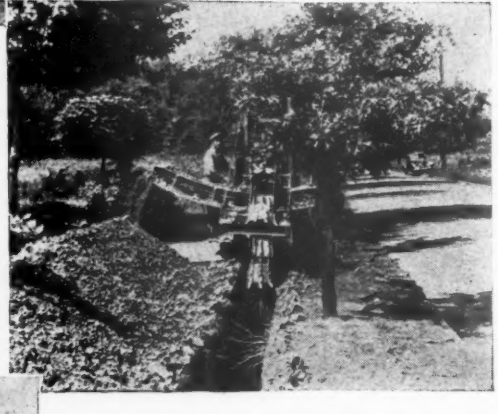

Because of their compactness, absence of bulk and dead weight, their quick shift conveyor and full crawler mounting "CLEVELANDS" can be DEPENDED on to overcome quickly the many handicaps encountered in digging Trench in congested areas. Note in illustration at right how "CLEVELANDS" travel along the tree lawn and sidewalk without damage and how easily the conveyor can be positioned to pass trees, poles or other obstacles.

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Sales manager

Joe W. Greene has been appointed general sales manager of The Ohio Injector Company of Wadsworth, Ohio, manufacturers of OIC bronze, iron and steel valves, according to announcement by P. M. Arnall, executive vice president.

J. W. Greene

Greene has had many years of experience in the valve field, having made headquarters in the southwest and middle west and east for the last 20 years, handling the oil, power, and construction industries.

The Ohio Injector Company, founded in 1883, has specialized in the manufacture of industrial valves of all types and some time ago completed its new steel valve plant, one of the most modernly equipped in the country.

Reading list

A revised "Reading List for Junior Engineers" has been issued by the junior committee on professional training of the Engineers Council for Professional Development and is now available for distribution. The reading list, reprinted in a convenient form from the twelfth annual report of ECPD, is a revision of the original 1936 list, which has been revised by a committee of which F. J. Van Antwerpen was chairman. It covers natural science, philosophy, including religion, economics and sociology, psychology, business and industrial management, literature, including poetry, essays and fiction, history, biography, travel, and the fine arts.

Copies of the "Reading List for Junior Engineers" may be obtained by addressing the Engineers' Council for Professional Development, 29 West 39th Street, New York 18, New York. Price, 10 cents each, or 5 cents each in lots of 50 or more. (In Canada, direct inquiries to The Engineering Institute of Canada, 2050 Mansfield Street, Montreal 2.)

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REFINERY CONVERSION FOR PREMIUM MOTOR FUELS

By **W. A. GOLDTRAP** and **BRADLEY SKINNER**
Chemical Products Department, Phillips Petroleum Company

EXCLUSIVE PRODUCTION of high quality postwar motor fuels is of prime interest to most refiners. Prewar motor fuel octane numbers were generally met through thermal cracking of gas oils and reduced crudes. Indicated postwar octane levels, however, will necessitate an upgrading in octane number of both straight run and cracked gasolines.

Generally speaking, reforming and cracking processes operating under more severe operating conditions to produce higher octane gasoline are accompanied by a greater production of highly unsaturated light hydrocarbons. These olefinic light ends, which in the past have been regarded as losses, may be utilized to a marked overall advantage through catalytic polymerization or gas reversion. Catalytic cracking of heavy oils not only produces better gasoline than conventional thermal cracking but also produces a gas containing a larger proportion of valuable propylene and butylenes. Catalytic reforming may also be used for upgrading low octane straight run or cracked naphthas.

As catalytic cracking and reforming, gas reversion, and catalytic polymerization represent three major processes for upgrading of gasoline, a brief discussion of these processes, together with comments on their utilization may be of interest to refiners.

The principal items of equipment used in these processes are the same as are used in the conventional and familiar thermal cracking units. Accordingly, few strange or new operational problems will confront a refiner converting his present equipment to these processes. These facts should be considered when reviewing the following process descriptions.

● **Cycloversion process.** A rather new addition to the field of petroleum refining is the catalytic cracking of gas oil fractions and catalytic reforming of low octane gasoline or naphtha fractions to produce high yields of premium motor fuels. Phillips' cycloversion process produces this result in a relatively simple operation as proved by tests on a large commercial unit, as well as semi-commercial and bench scale units.

A discussion of catalytic cracking, gas reversion, and catalytic polymerization, three major processes for upgrading of gasoline.

The principle upon which this process operates may be easily understood by comparing it with the older conventional cracking unit. By replacing the thermal reaction chamber with a chamber filled with a suitable catalyst, the cracking occurs at somewhat lower temperature and pressure. Gasoline produced catalytically has a substantially better octane rating and higher yields than gasoline produced by thermal cracking the same gas oil charge stock.

The cracking of a gas oil from Gray and Hutchinson counties, Texas, crude oil gives a thermally cracked gasoline with a 58 to 60 ASTM clear octane number compared to 75 to 79 ASTM clear octane number consistently obtained through cycloversion cracking. Another characteristic of the cycloversion gasoline, due partially to its olefinic nature, is a high sensitivity as indicated by research octane numbers of 86 to 88. Typical yield data for catalytic cracking of gas oil are shown in Table I.

Typical results from catalytic reforming of various straight run naphtha stocks are shown in Table 2. These data show yields of from 93 to 98.5 liquid volume per cent of the charge with increases of from 12 to 17 octane numbers better than the charge. Higher octane numbers may be obtained at somewhat lower yields. These data also show that the high lead response characteristic of the straight run charge is maintained. Part of the octane number increase and lead response is a result of the concurrent catalytic desulphurization of the charge. These data show sulphur reductions of from 80 to 94.5 per cent.

The flow diagram of the cycloversion process, shown in Fig. 1, is indicative of the comparative simplicity of this process. The basic components of a cycloversion unit are a heater and two or more catalyst chambers. The heater may be of conventional design, for it serves primarily to vaporize the feed stock and to superheat the vaporized feed and steam diluent to the desired reaction temperature. The combined vapors then pass through the beds of catalyst at temperatures of from 900° to 1100°F. and at a pressure that may be varied from below 50 to above 100 lb. per sq. in. gage. The effluent from the catalyst chambers is cooled in waste-heat exchangers, and the products are separated by conventional fractionating equipment.

In the cycloversion process the catalyst in one chamber is cracking the oil, while the catalyst in the other chamber is being reactivated. In this manner the flow of oil is maintained, and the cracking is continuous. The reactivation must occur periodically to remove deposits of carbonaceous material that accumulate on the catalyst during the cracking period. This carbon is removed from the

TABLE 1
Typical cycloversion yields and inspections from gas oil.

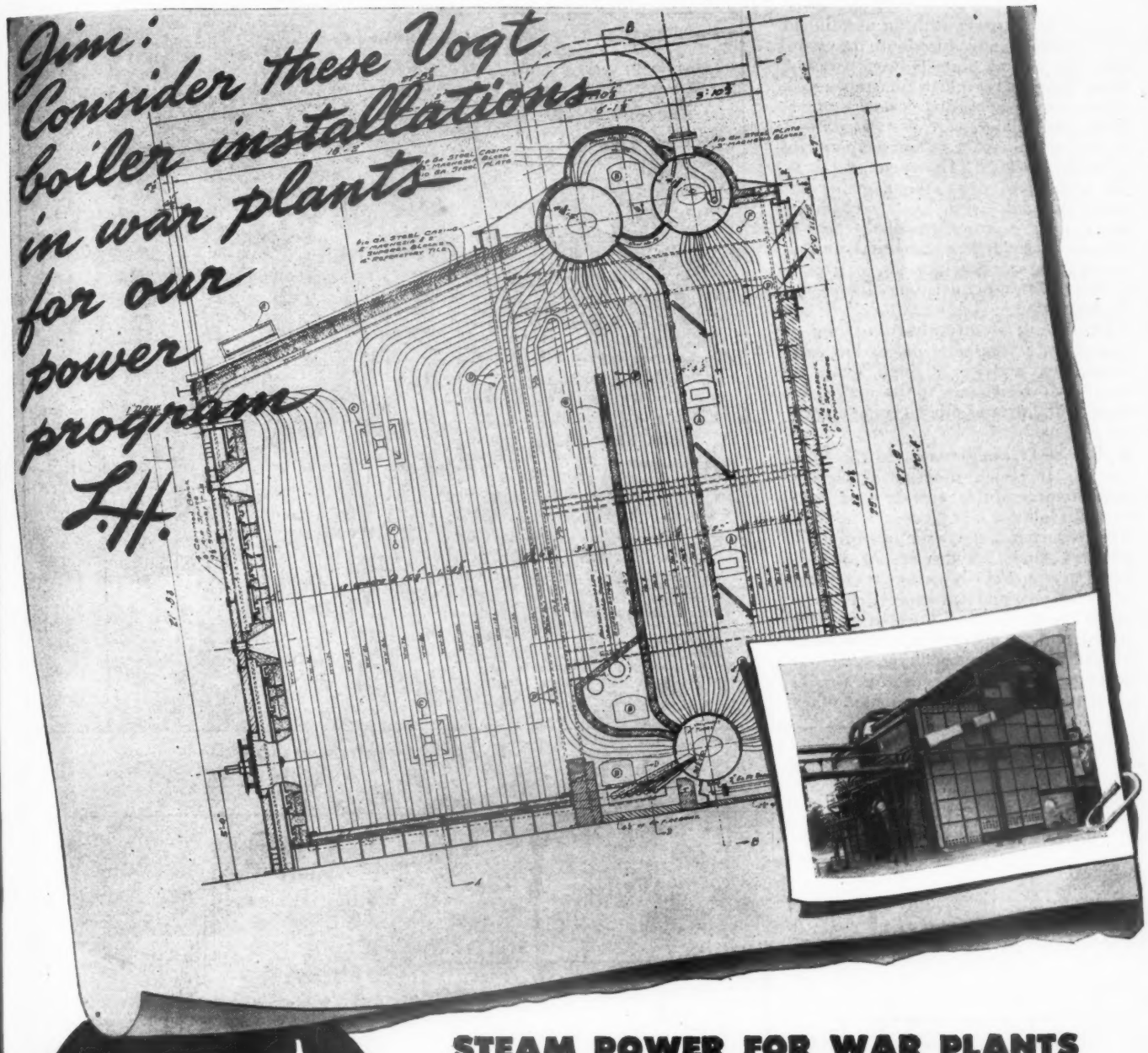
Charge stock Source		Gas-oil Gray and Hutchinson counties, Texas
Gasoline yield, vol. % charge		53.0
Inspection tests	Feed	Gasoline
Reid vapor pressure	....	10.0
Gravity, °API	36.6	59.7
Total sulphur, wt. %	0.36	0.05
Distillation, ASTM		
IBP, °F	275	91
10%	510	127
50	606	240
90	717	356
EP°F	....	392
Octane numbers		
ASTM, 0 cc TEL	....	76.3
1 cc TEL	....	79.0
3 cc TEL	....	81.5
Research, 0 cc TEL	....	86.1
1 cc TEL	....	90.5
3 cc TEL	....	92.7

TABLE 2
Typical cycloversion reforming yields and inspections.

Charge stock	S. R. naphtha Pennsylvania		S. R. naphtha Mid-Continent		S. R. naphtha West Texas	
Gasoline yields, vol. % of charge	92.9		98.5		94.1	
Inspection tests	Feed	Gaso.	Feed	Gaso.	Feed	Gaso.
Reid vapor pressure	8.5	10.2	4.0	10.1	2.6	8.3
Gravity, °API	62.2	62.8	59.0	59.0	54.8	55.1
Total sulphur, wt. %	0.055	0.005	0.04	0.008	0.14	0.008
Distillation, ASTM						
IBP, °F	100	88	121	105	144	100
10	156	137	189	179	198	165
50	262	248	254	259	259	245
90	353	343	321	325	343	331
EP. °F	404	409	366	377	394	408
Octane numbers						
ASTM, 0 cc TEL	48.8	61.5	41.1	55.3	56.5	68.3
1 cc TEL	57.3	71.0	53.5	68.8	63.7	77.5
3 cc TEL	67.1	79.6	67.0	78.4	70.0	83.1
Research, 0 cc TEL	49.6	65.8	...	...	59.1	74.3
1 cc TEL	57.9	74.4	...	...	66.0	83.2
3 cc TEL	68.7	83.5	...	...	72.1	88.4

Jim: Consider these Vogt boiler installations in war plants for our power program

L.H.



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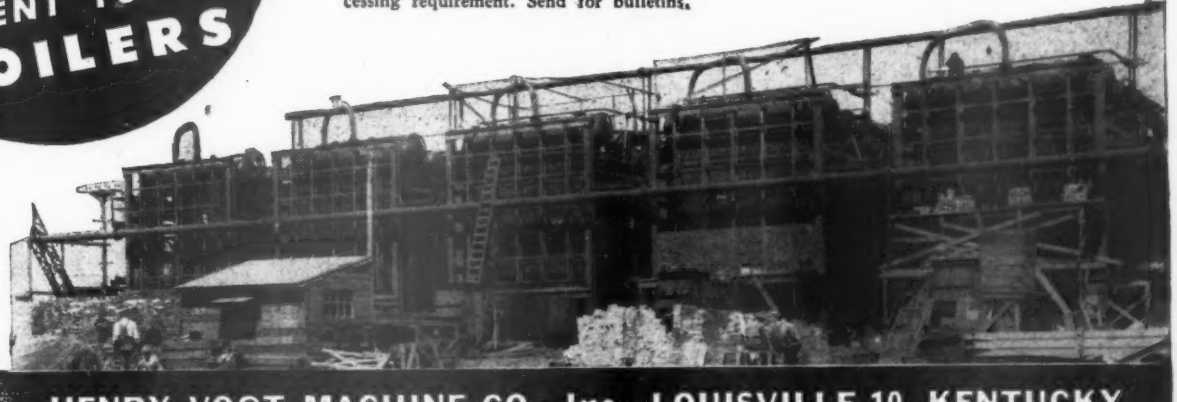

HENRY VOGT MACHINE CO., Inc., LOUISVILLE 10, KENTUCKY

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catalyst by burning with an air diluent mixture that is introduced into the chamber inlet and at ports between catalyst beds. Steam or recycle combustion gases, depending on operating costs for a particular installation, are used as diluent to control the reactivation temperature at 1350 to 1400°F. The spent reactivating gases pass from the chamber directly through waste-heat exchangers where a large proportion of the heat is recovered. A large commercial unit is running on cracking periods of from 4 to 10 hr. with an equal time allotted for the reactivation.

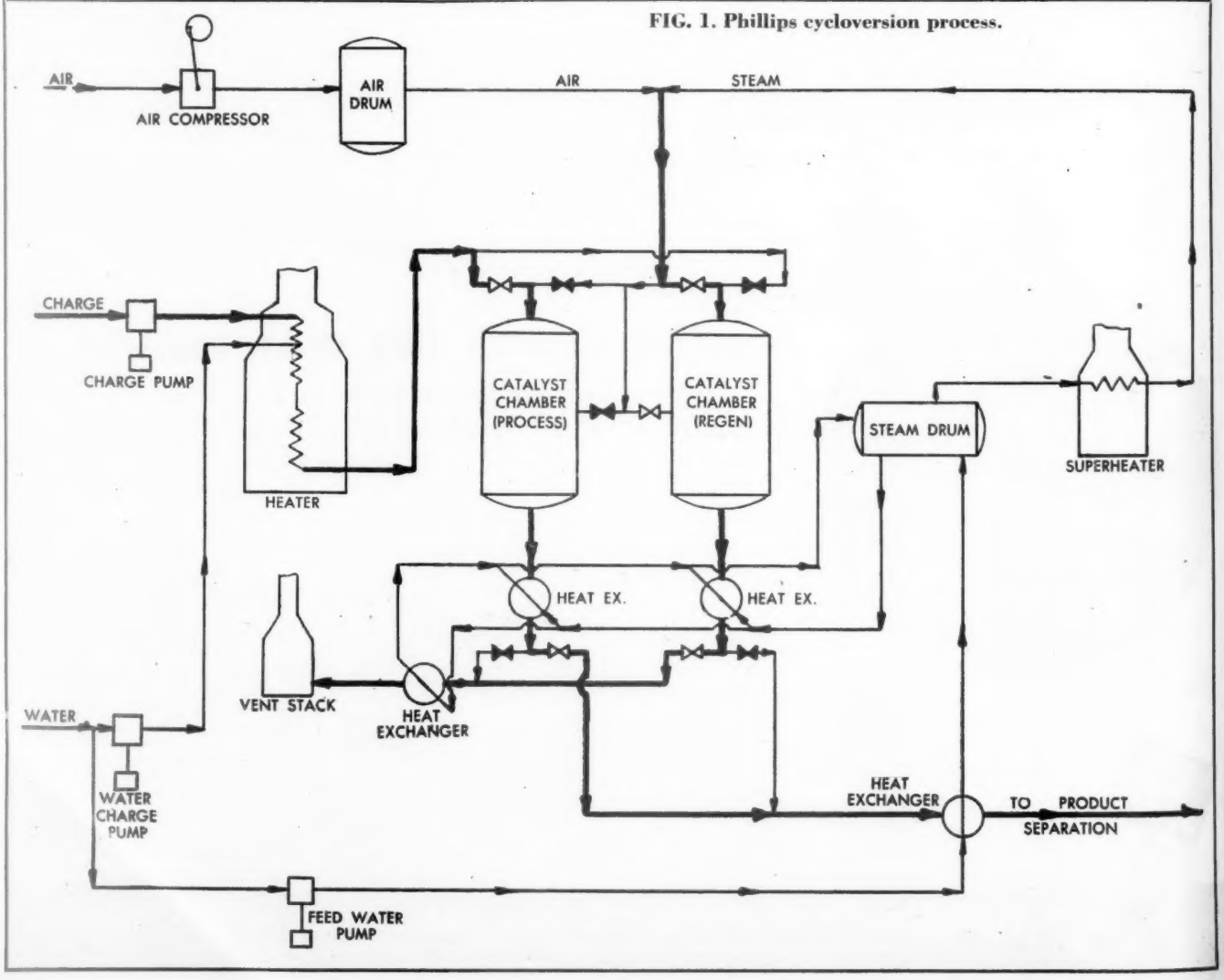
The cycloversion catalyst is extremely rugged and is characterized by low cost, maintained activity at high temperatures, and resistance to poisoning by steam, sulphur and other common catalyst poisons.

● **Gas reversion process.** In the Phillips gas reversion process, which has been in successful operation on a commercial scale for many years, a mixture of hydrocarbon gases, usually virgin and recycle C_3 and C_4 hydrocarbons, is subjected to a partial conversion at elevated temperatures and pressures. A preheated naphtha is then injected into this stream, and the conversion is allowed to proceed in a common soaking section at somewhat reduced temperatures. Cracking, polymerization, akylation, and other

TABLE 3. Typical gas reversion product yields and inspections.

	1		2		3	
Column number						
Charge (gasoline from Gray and Huchinson counties, Texas, crude)						
Naphtha, %	100.0		100.0		100.0	
Outside gas feed, % on naphtha	100.0		100.0		100.0	
Tota charge, % on naphtha	200.0		200.0		200.0	
Gasoline yield: (Based on naphtha charge)						
Vol. % 8.5 lb. RVP	134		128		119.5	
Inspection tests	**Naphtha chg.**	**Prod. gaso.**	**Naphtha chg.**	**Prod. gaso.**	**Naphtha chg.**	**Prod. gaso.**
Gravity °API	60.6	62.0	59.6	61.5	58.7	59.8
ASTM distillation						
IBP °F	110	93	105	98	104	98
10%	160	123	157	132	162	137
50%	250	210	255	204	261	203
90%	373	345	400	339	410	321
EP. °F	428	406	446	408	450	405
Total sulphur, wt. %	...	0.09	0.12	0.10	0.11	0.09
Octane numbers (at 6.5 lb. RVP)						
ASTM, 0 cc TEL	47.8	69.0	....	73.0	49.4	75.5
1 cc TEL		74.0		77.1		79.1
3 cc TEL		80.5		81.0		82.6
Research 0 cc TEL		....		....		88.0
1 cc TEL		....		....		92.1
3 cc TEL		....		....		94.7
Outside gas feed						
Analysis, liq. vol. %						
Methane		2.8		2.8		2.6
Ethylene		1.0		1.5		0.5
Ethane		11.0		23.9		13.9
Propylene		4.7		15.2		5.9
Propane		52.3		54.4		38.6
Butylenes		2.0		...		2.9
Butanes		26.0		2.2		35.5
Pentanes		0.2		...		0.1
Total unsaturates, liq. vol. %		7.7		16.7		9.3
Total sulphur, wt. %		....		0.83		0.44
Fuel oil						
Average, per cent on naphtha chg.	3%					
Gravity, °API	12.0					
SFV@ 122°F	90.0					
BS. & W.	0.2					

FIG. 1. Phillips cycloversion process.



reactions occur that involve both the gaseous hydrocarbons and the naphtha. During these reactions some high boiling tars are formed, and since these tars are diluted by the light gases, their dew point is considerably reduced below the soaking coil temperature. Relatively little difficulty, therefore, is encountered due to plugging of the furnace tubes or transfer line even under drastic operating conditions.

The quality and yield of gasoline produced by this process varies with the furnace conditions, ratio of gas to naphtha, and composition of the gas and naphtha charged. When equal liquid volumes of gas and naphtha are charged, the ASTM clear octane number of the 90° to 400°F. end point gasoline ranges from about 69 to 75.5 depending upon furnace conditions. The lead susceptibility of this gasoline is also good. Typical charge and yield data are shown in Table 3. It should be noted that the C_3 and C_4 content of the outside gas feed varies from 71.8 to 85 per cent. Furthermore, gasoline yields are from 120 to 135 per cent of the naphtha charge. It should be noted that the corresponding inspection tests are on a plant treated copper sweetened product.

A flow diagram of the gas reversion process is shown in Fig. 2. The poly feed, consisting of normally gaseous hydrocarbons, and a naphtha feed, are separately heated under pressure prior to the mixing of the two streams. The poly feed is heated to temperatures in the range of 900° to 1100°F. and at a pressure of about 1600 lb. per sq. in. gage where partial conversion is effected. The naphtha feed is heated in another coil under a similar pressure to about 800°F. These two streams are then combined in a third coil where the gas reversion reactions occur.

From the outlet of the gas reversion coil, the products pass through heat exchangers and a pressure reduction valve to a fractionating column. The overhead product of this tower is cooled and partially condensed to provide the C_3 and C_4 hydrocarbons for reflux and recycle feed. The uncondensed portion passes off as residue gas. The kettle product from the tower passes on to a rerun unit

(Continued on Page 182)

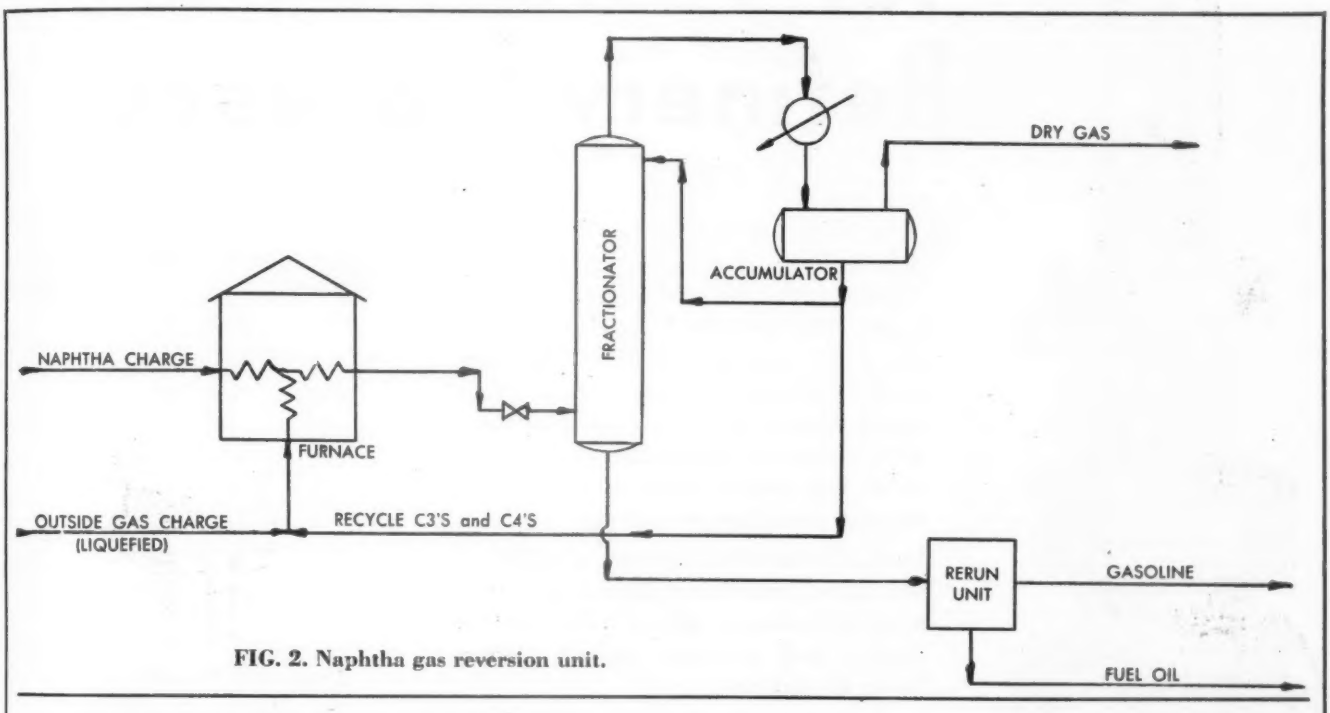
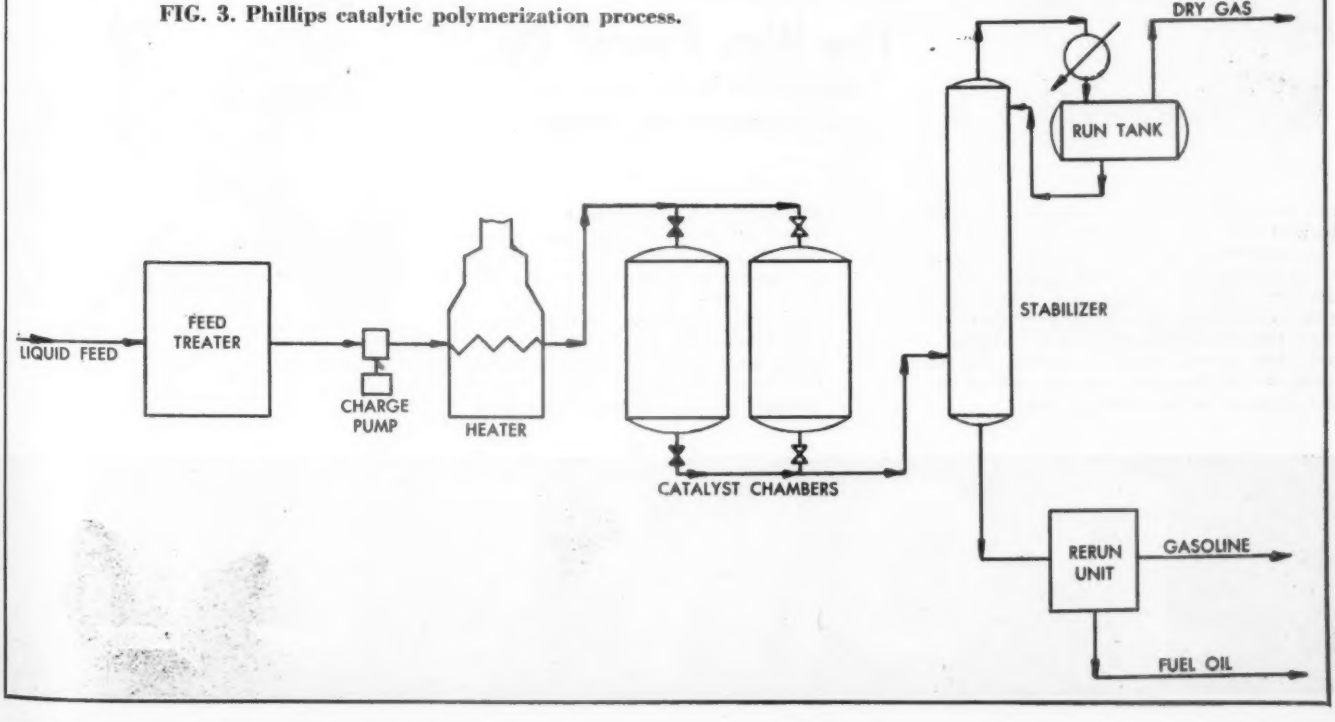


FIG. 2. Naphtha gas reversion unit.

FIG. 3. Phillips catalytic polymerization process.



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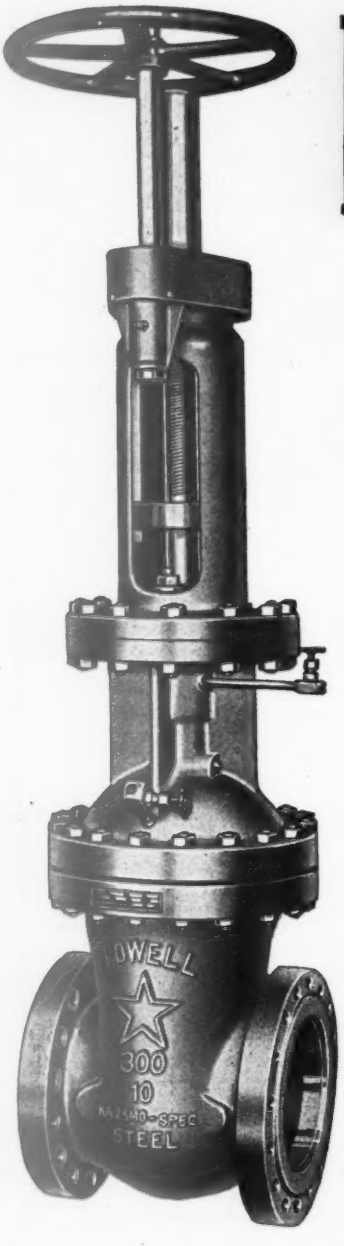

This is our promise to the Oil Industry! Just as Powell Engineers, working hand in hand with refinery engineers, have designed and produced the flow control equipment necessary to meet the many new requirements of war-inspired petrochemical processes, so will they be ready with valves to handle the media, pressures and temperatures to be encountered in processes yet unborn.

Backed by nearly a century of practical, specialized experience, Powell Engineers have accumulated valuable data on flow control that is yours for the asking. Write for details.

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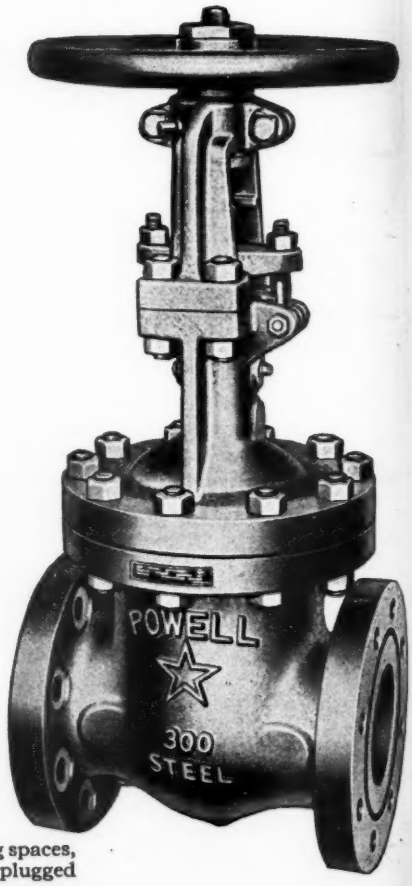

300-pound Gate Valve, designed and made to withstand the ultra-high temperatures encountered in thermal catalytic cracking. Body and bonnet are cast of stainless alloy. Stellited double wedge disc, seats, disc guides and stem guides. Spur gear operated. Drain valves in stuffing box and bonnet. Also provided with cooling fins to dissipate the heat and thereby reduce the temperature in the stuffing box.

Fig. 3003—A 300-pound Cast Steel Gate Valve. Has ring joint flanges. Extra long stuffing box provides space for ample packing below and above lantern ring. This arrangement protects packing above lantern ring and eliminates leaks. Opposite sides of packing spaces, at the lantern ring, are drilled, tapped and plugged for either attaching a drain, if necessary, or providing for lubrication at this point.

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300-pound O. S. & Y. "Y" Valve, especially designed and built for handling hydrofluoric acid in alkylation plants. Has ring joint end flanges and body-bonnet connection. Equipped with Powell Patented Seat Wiper. This type of valve provides the straightway, full flow area of a gate valve plus the throttling feature of a globe valve.

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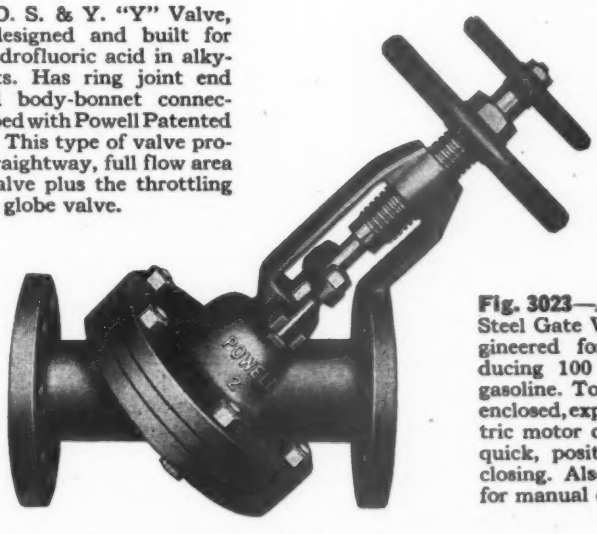

Fig. 1097SW—Special Alloy Separable Body Reversible Seat "Y" Valve, especially adapted for handling hydrochloric acid in isomerization units. Provides straightway flow area through the body. Equipped with Powell Patented Seat Wiper for clearing seat and disc faces of adhering material, assuring a leak-proof metal to metal contact.

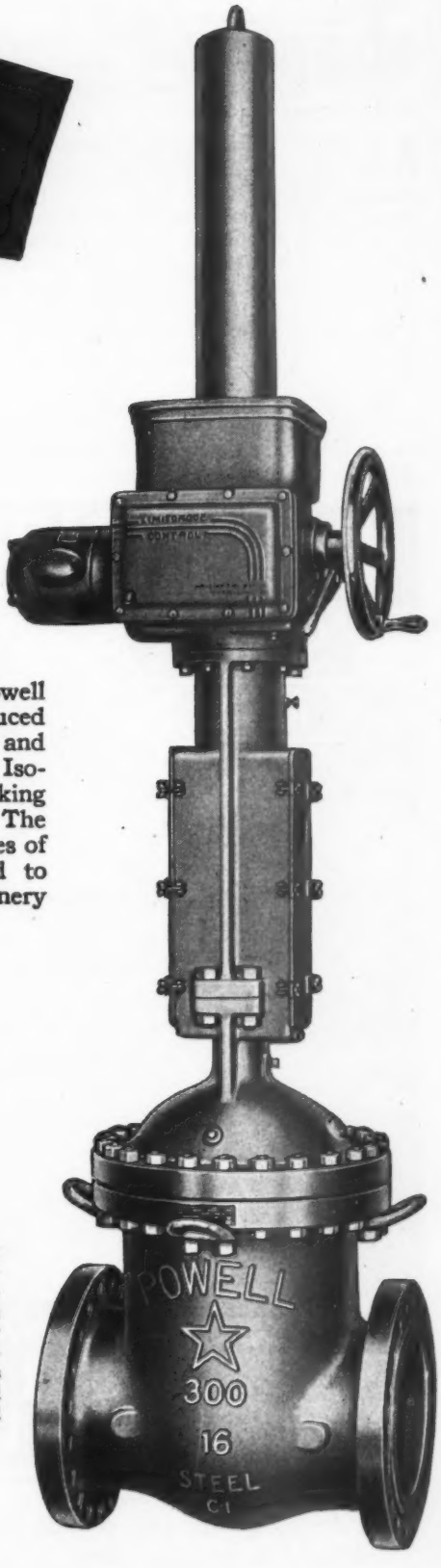

Fig. 3023—A 300-pound Cast Steel Gate Valve, Powell engineered for refineries producing 100 octane aviation gasoline. Top-mounted, fully enclosed, explosion-proof electric motor operator provides quick, positive opening and closing. Also has handwheel for manual operation.

VALVES

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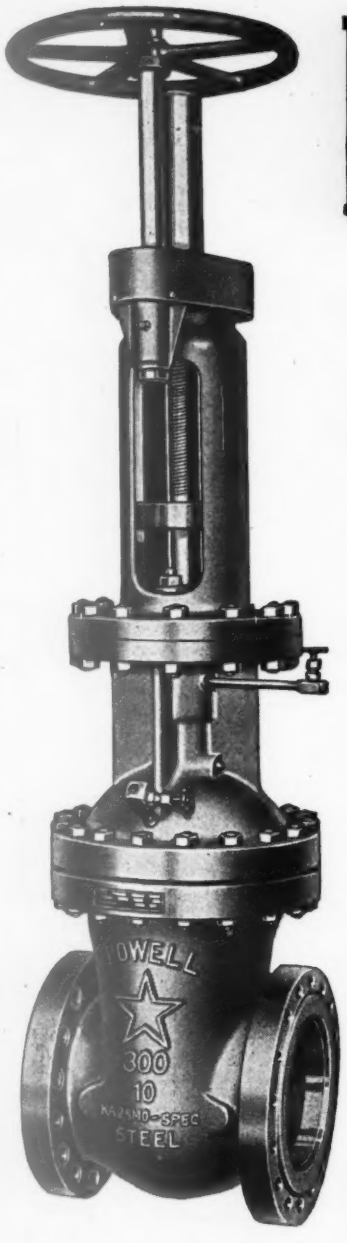

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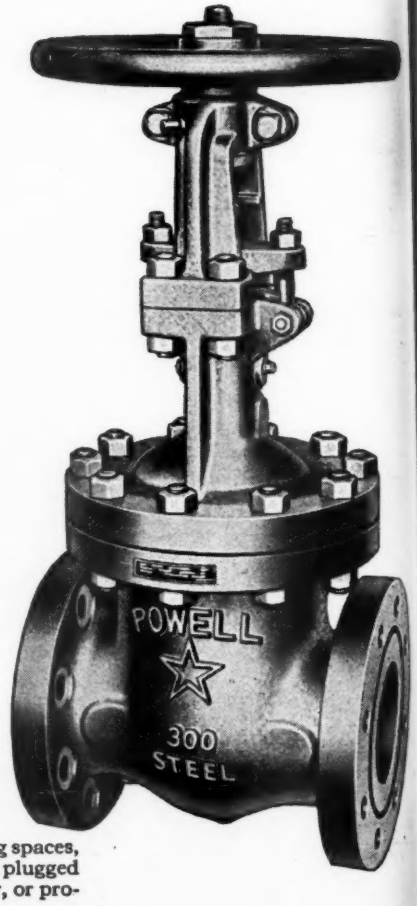

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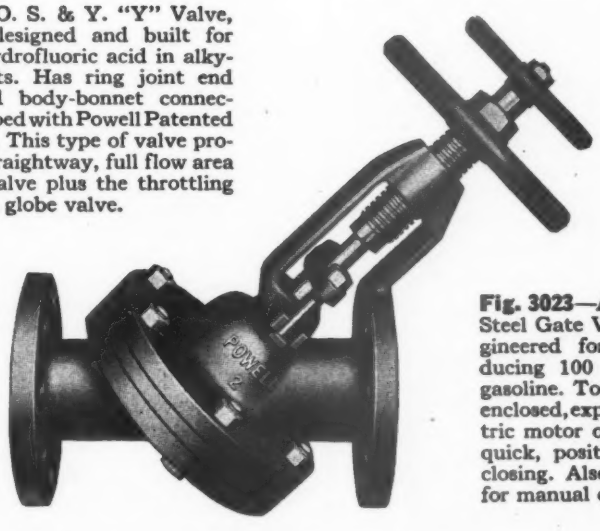

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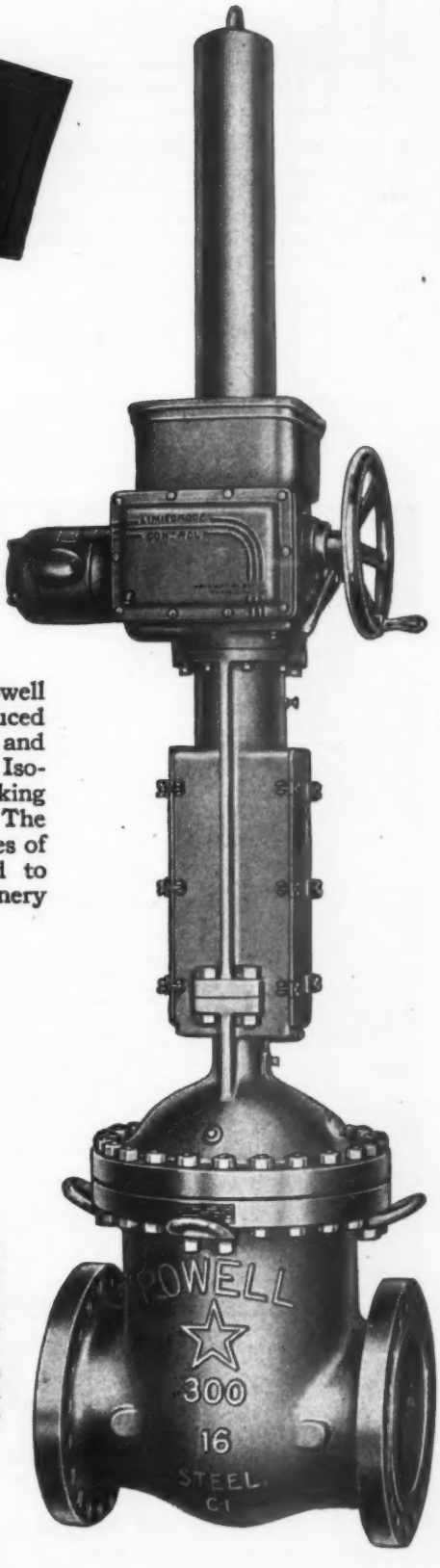

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VALVES

(Continued from Page 179)

where the gasoline is fractionated for the desired vapor pressure and end point. The fractionated product may be further treated if desired.

● **Catalytic polymerization process.** Phillips has developed and operates a catalytic polymerization process for production of gasoline from gaseous olefins. This process in effect is a devolatilizing process, for it permits incorporation of large volumes of propylene and butylenes into motor fuel by conversion into a low vapor pressure, high octane gasoline through the polymerizing action of the catalyst.

The olefinic gasoline produced by the polymerization of mixed light olefins has an ASTM octane number of from 80-84 with excellent blending values of from 95 to 100. Generally the yield of gasoline will be from 60 to 70 per cent of the C_3 and C_4 olefin feed. Thus catalytic polymerization not only contributes to the production of high quality motor fuels, but it also increases the volume of gasoline from the crude oil.

The accompanying flow sheet, Fig. 3, shows the simplicity of the process. The poly feed, consisting of saturated and olefinic light hydrocarbons, is caustic washed to remove sulphur compounds that would be partially fixed in the polymer. The poly feed stock is then pumped under pressure through a heater where the charge is heated to a temperature of 225 to 500°F. From the heater the charge flows through the catalyst chamber where it is contacted with the polymerizing catalyst. Two or more chambers are used in order that a chamber may be taken off stream periodically for catalyst replacement. The effluent from the catalyst chamber then flows through coolers and a pressure reducing valve to a stabilizer that separates the gasoline from the unreacted light hydrocarbons. This stabilized product is then rerun for the desired end point.

The polymerization catalyst is a noncorrosive, gel-type, silica-alumina composition, developed and manufactured by Phillips, and it has proved to be rugged and long lived. The catalyst is generally charged to the converters, utilized until the activity has fallen to an uneconomical operating point, and then discarded.

● **Refinery utilization.** The interrelation between these three types of processes may be utilized in many ways, depending on the size of the refinery and other factors. Much of the equipment involved is conventional, and if unused or older type equipment is available, most of it can probably be used in a conversion program for fractionating, heating, pumping, and other services.

The cycloversion process may be utilized to produce high octane gasoline from gas oils along with light olefins for catalytic polymerization or alkylation processes. The flexibility of the cycloversion process also permits its use for catalytic reforming of naphthas.

Optimum operating conditions for catalytic reforming of straight run gasoline and naphthas and for catalytic cracking of gas oils are very similar for the cycloversion process, and they suggest the practicality of processing long cut distillates. In this manner investment and operating costs may be materially reduced per barrel of charge through the operation of a larger unit, and the overall octane level will be materially increased. Both gas oil cracking and naphtha reforming produce highly olefinic light hydrocarbons, which can be recovered as gasoline by catalytic polymerization. Catalytic polymerization units are relatively small and should be incorporated in most cracking refineries due to the benefits obtained with minor expenditures. If cracking facilities are increased through the additions of or conversion to catalytic cracking and catalytic reforming, catalytic polymerization should definitely be considered in the program.

The gas reversion process also has extensive possibilities, especially in refineries where more than normal supplies of light hydrocarbons (either saturated or unsaturated) are available. If catalytic polymerization is incorporated, the gas reversion gas feed will be rather low in olefinic content, which will result in slightly lower yields. Somewhat higher yields are produced with an olefinic gas feed. If the olefins are converted on a catalytic polymerization unit, however, high octane number codimer is produced that can be used to great advantage in the blending of unusually high octane number gasolines. ★★★

CORROSION,
SCALE,
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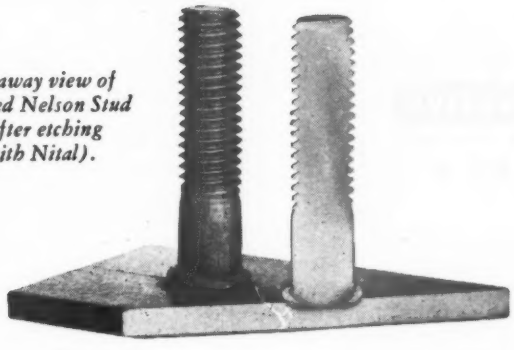
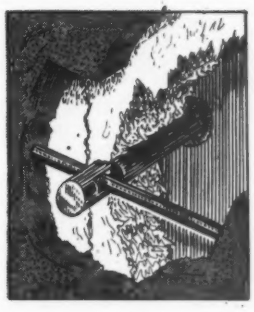
Here are a few of the ways thousands of Nelson Stud Welders are used . . .

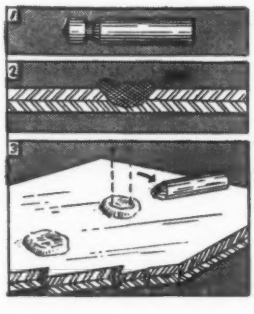


Cutaway view of welded Nelson Stud (after etching with Nital).

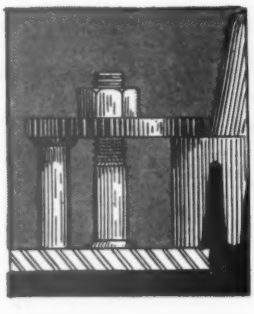
Thousands of Nelson Stud Welders are now used by more than 500 industrial plants and shipyards in applications similar to these. This process eliminates time and material consumed in hand-welding bolts, or drilling and tapping for studs. The *complete fusion* of the stud to metal is obtained *in 1/2 second* . . . and the resulting weld is stronger than the strength of the stud!



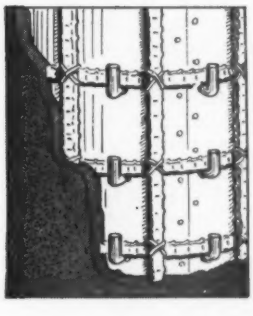
Lagging studs secure magnesia blocks for insulation purposes. The studs are welded, and wire slipped through the hole. The blocks are then placed under the wire and the wire is pulled tight. Plaster covering is then installed over the lagged area if desired.



Plug welding is used to fasten light-gauge steel to structural steel or flat surfaces. Hole is punched in the top plate. Nelson Grooved Stud (1) is then welded through the hole to the bottom plate, fusing the two together (2). The stud is then broken off (3) and the weld bead is removed if desired.



Bubble tower caps are now being secured with Nelson Studs. A stud is used as a spacer on a large diameter washer. Another stud is welded to the grille baseplate which supports the cap, and the washer is tightened down, securing the bubble cap. One washer will secure four caps in this manner.



Reinforcing cement of the sprayed-on type is another typical application for the Nelson Stud Welder. The studs are used to secure the reinforcing wire. Studs may be welded straight and bent to desired position, or welded bent. This application is excellent and is now being used to line storage tanks, vats, stacks, etc.

e Nelson ectric Arc Stud Welder

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NELSON STUD WELDERS & STUDS

DESIGN OF OIL PIPE LINES

By FRITZ KARGE, *Chief Engineer, Pipe Line Department*
Union Oil Company of California

EXCLUSIVE

PART 2

Continuation of an article begun in March discussing factors important to design and construction of pipe line system.

● **Accuracy of flow formulas.** The question might arise of what degree of accuracy to expect from the use of these graphs and formulas. The writer counters this question with the suggestion that we first investigate what degree of accuracy is required. Suppose the engineer is engaged in determining the proper size and calculating the friction loss for the many pipe lines connecting the units of a proposed refinery plant. Some lines will operate under vessel pressure differentials, others by pump pressure. For each line there must be given the maximum flow rate required, the temperature of the oil, its viscosity and specific gravity at the flow temperature, the probable length of line, the number and type of fittings, valves, controllers, meter orifices, and other pressure drop creating devices, and the difference in elevation between each line's terminals. Chances are that most of these factors will be given on the process flow sheet. The length of the line and the number and type of fittings will very likely have to be assumed, for these calculations usually precede the detail layout of the piping. Having collected all necessary information to the required standard of accuracy, the engineer will proceed with the calculations, determining the required pipe size on the basis of velocity, perhaps, as previously referred to. If the factors are correct, the pressure drop calculations will be within 10 per cent of correct values, in accordance with Pigott, who states:

"The variation of test points from the average curves chosen is plus or minus 10 per cent for the steel pipes."

The writer's own observations lead him to say that Pigott's values are on the safe side.

Plus or minus 10 per cent may not seem a desirable degree of accuracy. How accurate are the factors entering these calculations? Returning to the design of the interconnecting lines in a refinery plant, it can perhaps be stated that all factors but the flow rate and the equivalent length of line, including line and fittings, will be fairly correct. The flow rate will be that for which the plant is designed. The customary experience, however, is that the plant will naturally have greater than the design capacity, the process designer having used ample safety factors, or that the plant will be forced to handle a greater throughput. The designer of the pipes, therefore, will do well in also allowing an ample safety factor not only with respect to the flow rate, but also in the length of the lines and the number of pressure-creating fittings, etc. Pipes are made in certain standard sizes and it will happen rather seldom that the diameter for a given velocity will exactly fit one of the standard pipes. Usually the next larger size is chosen. The difference between the calculated and chosen diameter constitutes a safety factor. For such design work, therefore, the flow formulas can be credited with an accuracy well within that of some of the important factors entering them.

For the design of a long cross-country oil pipe line, a higher accuracy seems desirable. In the design of the Big Inch line, for instance, a minus or plus 10 per cent variation would have resulted in an unnecessary 10 per cent increase in the number of pump stations, if the actual pressure drop were 10 per cent lower than that given by the Pigott curve, or the pipe line would have a lower capacity if the actual pressure drop were 10 per cent higher. The design of such long and large lines will be intrusted only to engineers with extensive experience in handling the type of oil to be transported. Very likely they will have accumulated test data of their own on operating pipe lines.

As stated before, the writer's observations indicate that Pigott's friction factors are on the safe side. The lowest curve "A" on Graph 2* follows observations made on Mid-Continent crude by W. G. Heltzel, vice president of the Stanolind Pipe Line Company and connected with the engineering staff of the Big Inch pipe line, and by Standard Oil Company of California on California crudes. The data are in agreement for all practical purposes. The writer has designed a number of pipe lines with this curve. The operating capacity agreed remarkably with design capacity. The curve used for the design of the 24-in. Big Inch line falls just a little below the "A" curve. The friction factor graph in McAdams "Heat Transmission," second edition, apparently uses Pigott's curve for 6 to 12-in. pipes. It bears the notation, "plus or minus 10 per cent." The Crane Company's nomographs are also based on Pigott's work.

The designing engineer will hardly be criticized if the pipe line operates at a pressure somewhat lower than the design pressure.

● **Design of light oil pipe lines. Factors required.** The following factors must be determined and set down as accurately as possible before a rational design of a pipe line can be undertaken. The longer the line the more important is accuracy in these factors.

1. *Maximum capacity required.* If the line is to serve a new oil field, its required maximum capacity can probably be only estimated by the production engineers and geologists. In most cases it will pay to be optimistic. A curve showing the estimated rate of production increase to maximum production and the decline of production is valuable to the designer. Very likely, however, he will be told to design for a given maximum capacity. Others will take the responsibility for its choice.

2. *Probable life of field.* This again is a guess during the early stages of a new discovery. Most oil fields have a long enough life to pay out the investment cost of a generously sized pipe line with relatively low friction losses. If the depth, extent, etc., of an oil sand definitely precludes a long life (and that has been the case in a few fields), a small size pipe line with higher pumping costs for a short period might be the answer.

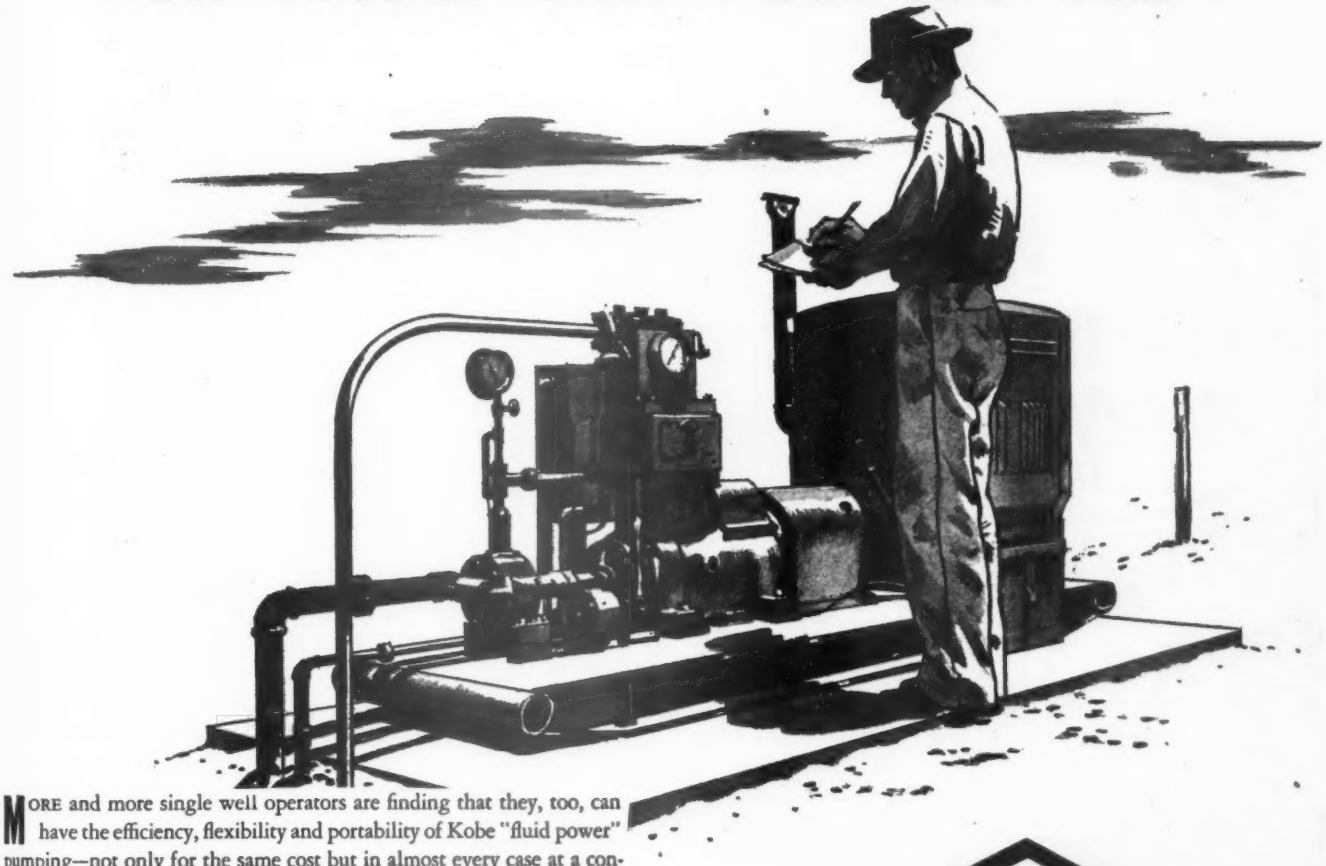
3. *Viscosity of oil and API or specific gravity.* The viscosity should be determined for a number of fresh, unweathered samples. This characteristic of the oil might increase a little with the age of the field, or considerably when the oil is in later years produced as an emulsion. Curves are available showing the percentage increase in viscosity for increasing water cuts. This phase will not affect the design if the oil is to be dehydrated in the field before being shipped. The laboratory will report the API gravity with the viscosity.

If waxy crudes are to be transported, consideration should be given to the

*See Part 1 in *The Petroleum Engineer*, March, 1945.

Right

FOR SINGLE UNIT PUMPING TOO



MORE and more single well operators are finding that they, too, can have the efficiency, flexibility and portability of Kobe "fluid power" pumping—not only for the same cost but in almost every case at a considerable saving. This applies both on original outlay and operating costs.

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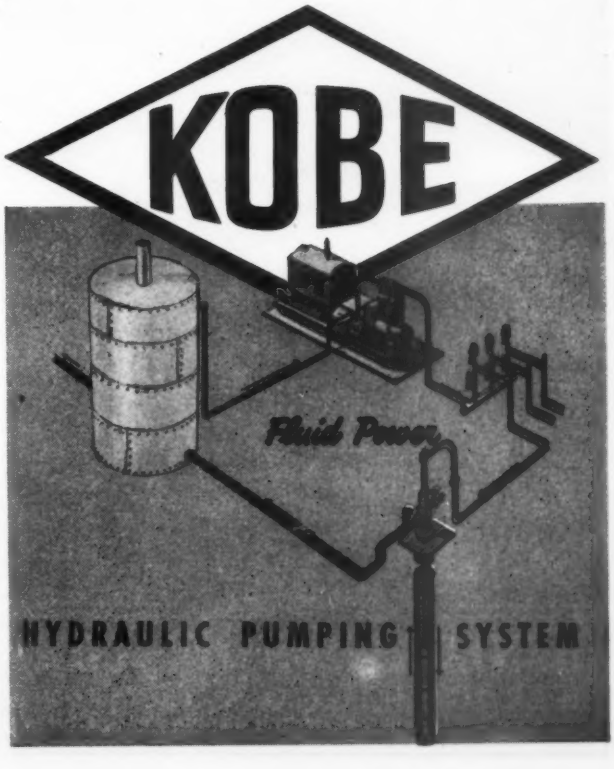
No matter what your single well problem may be, your nearest Kobe representative has the solution. Call him today.



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probable reduction in the pipe line's capacity due to wax deposition. Traps for inserting and removing scrapers are then advisable.

4. *The profile of the route of the pipe line.* Some profiles will be level. In others an adverse head must be considered in the calculations, and in still others a favorable drop will be available.

5. *Physical features along pipe line route.* For the pressure drop in light oil lines the physical features are of relatively small importance unless they are extraordinary, such as long stretches of very wet ground. They enter into the cost of the line, however. They are very important for pipe lines carrying a heavy oil that must be heated to move it economically. This subject will be discussed in more detail later.

6. *Pumping and flowing temperatures.* Light oils are more often than not pumped at atmospheric temperature. During the hot summer months, the flow will be nearly isothermal, for the ground at the customary depth of 30 in. is at a temperature of from 70 to 75°F. in most of the California oil districts. During the winter months the ground temperature at that depth will seldom fall below 50°F., and only where a pipe line traverses a high elevation such as the Tejon Pass it might drop to 40°F. In the design the viscosity at 50°F. should be used in California in order to insure full capacity also during winter weather, for the oil will cool to that temperature even if pumped warmer. The line will then have surplus capacity during the warmer months. In other localities, different temperature ranges between summer and winter pertain and must be considered. Further reference will be made to this subject in connection with the discussion of lines for heavy oil.

● **Calculations.** With all these factors determined, the engineer can now proceed with the actual design, applying or not applying a safety factor in the flow rate and viscosity as judgment may dictate. The friction factor graph and formulas to use will also be left to judgment or preference. It is well to proceed in orderly fashion and to calculate the total pumping pressure for 2 or 3 sizes of pipe, tabulating the results so that they can be quickly compared.

● **Pumps and drivers.** The next step will be the selection of pumps and drivers suitable for the desired rate and calculated pressures for the different size pipe lines. A standby pump is usually advisable. For some conditions it is advantageous to install 3 units, each of a capacity of one-half the pumping rate. Centrifugal* pumps are unquestionably most suitable for moving light oils of viscosities below say 300 seconds Saybolt universal. Whether to drive them with electric motors, steam turbines, diesel engines, or natural gas engine will largely depend on local conditions and on the availability of these power media. Variable speed drivers as steam turbines or internal-combustion engines are of advantage in many pumping plants, particularly if the immediate pumping rate is considerably lower than the maximum rate. Under these conditions, it will sometimes pay to pump at approximately the maximum rate, but only part time. Immediate and future conditions must be carefully considered in the selection of pumps and drivers.

● **Yearly cost of line.** A complete estimate of cost of each calculated line and its pumping machinery, together with an estimate of the cost of power, whatever its nature, will enable the engineer now to select the installation that will be the cheapest for the number of years he expects to operate the system. The cost of corrosion protection, if necessary, must be included. The yearly operating cost should include:

1. *Depreciation*, the rate often being determined by company policy rather than by engineering considerations.
2. *Interest on the depreciated balance*, also a matter of company policy.
3. *Power cost.*
4. *Cost of operating man power.*
5. *Cost of maintenance and supplies.*
6. *Insurance and taxes.*
7. *Supervision and overhead.*

The salvage value of line and equipment after its expected operating life must also be considered.

If the line is more than ten miles long,

*See "Some Problems in the Selection and Operation of Centrifugal Pumps for Oil and Gasoline Pipe Lines," A. Hollander, *ASME Transactions*, August, 1942.

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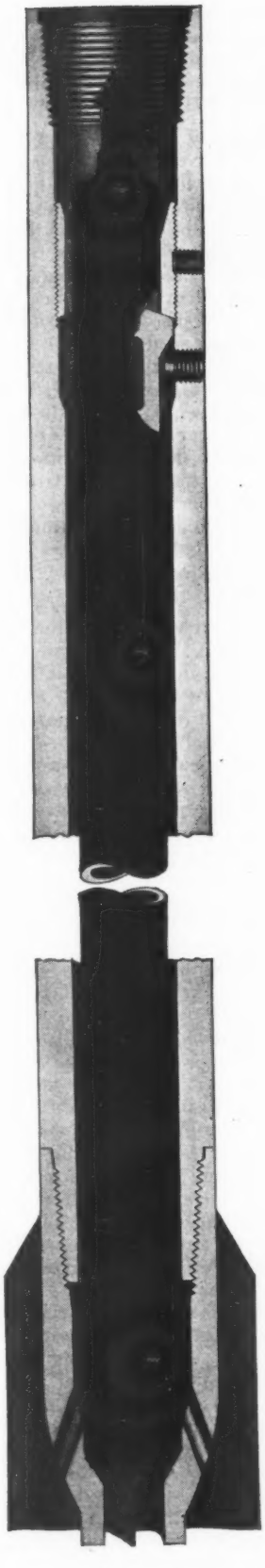

Floating Barrel

ONE OF MANY ADVANTAGES OF THE HUNT WIRE LINE CORE BARREL

● The Hunt barrel has no part in cutting the core . . . but merely receives it. It is therefore not necessary to drive the barrel, which seats in the drilling bit rather than protruding through it. A hold-down latch retains the barrel in position to receive the core.

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one of the larger size lines will usually be the most economical. The Big Inch line, for instance, (24-in. diam.) moves 300,000 bl. of 40 API gravity oil per day at only 2.5 lb. pressure drop per 1000 ft., the pump stations being spaced approximately 52 miles apart. A smaller line would have been more expensive in yearly cost because of the mounting power costs due to higher friction losses. The reader will recall that the pressure drop varies approximately as the inverse ratio of the fifth power of the pipe diameter. A line of still larger than 24-in. diam. was not chosen because pipe rolling and installation equipment was not available.

To illustrate the relative cost of operating larger and smaller pipe lines, we refer to a paper by the writer given in 1930 before ASME at Tulsa, Oklahoma, entitled "Economics of Pumping Oil at Low Friction Losses." The paper is a plea for larger pipe lines. Although there exists no connection between this paper and the design of the Big Inch line, this great project corroborates the paper's arguments. In recent years other lines of large diameter pipe have been installed and proved economical.

We call attention, too, to a paper by Oscar Wolfe, "Economic Design of Oil-Pipe-Line Transportation Systems," also presented before ASME in October, 1930, at Tulsa, Oklahoma.

Also see "Selection of the Most Economical Pipe and Valve Size and Rate of Flow in Piping Systems" by S. P. Johnson and F. L. Maker of Standard Oil Company of California, API Proceedings, Section III, Refining, Vol. 21 M (III) 1940.

● **Design of heavy oil line.** The design of a cross-country pipe line for heavy oil is somewhat more complicated. California produces large quantities of such oil. It must be heated in order to move it with reasonable efficiency. As it flows in the pipe line it loses heat to the surrounding earth and this, in turn, to the atmosphere. The viscosity of the oil increases and so does the pressure drop. Leaving a pump station, the flow will usually be turbulent, the viscosity of the oil being low enough to throw the Reynolds number of the flow condition to the right of the upper critical limit on the friction factor charts. Gradually the flow condition will change to that of unsteady turbulence, pass through the unsteady region and on to the left of the lower critical limit, where it becomes streamline.

● **Heat losses.** The determination of the cooling rate, that is, of the temperature gradient of the flowing oil, constitutes that part of the design calculations fraught with the greatest possibilities of inaccuracy.

A great deal of work has been done by pipe line companies operating heavy oil lines to establish the rate of heat losses under different conditions of flow for different soils surrounding the pipes, and for different weather conditions, both atmospheric temperature and rainfall. The tests usually consisted of tapping the lines every mile or two, measuring the temperature of the oil and deducing the rate of heat loss from the temperature drops between test stations and for the flow rates, noting also the depth of cover over the pipe, type of soil and moisture condition, atmospheric temperature and existence or nonexistence of wrapping. Most tests were conducted after the lines had been in operation for long enough periods to perform under conditions of heat loss equilibrium; that is, after the soil had been warmed up and the oil temperatures at each test station persisted without appreciable change.

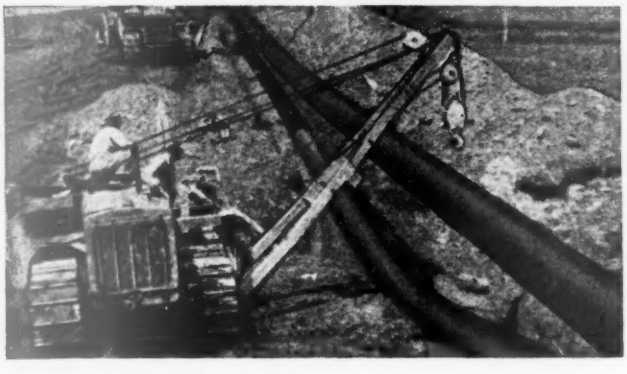
A few tests were made for the purpose of demonstrating the magnitude of the heat losses when plugging heavy oil through a cold pipe line. It might take 4 to 6 days of continuous pumping at the highest pressure the system can stand to reach capacity flow with a heavy oil. The lighter the oil, the shorter will be the warming-up period.

It is beyond the scope of this article to discuss at length the phenomenon of heat flow. Mentioning its most important aspects, however, may help develop a measure of judgment with respect to the factors to employ in the calculations of heat losses from a flowing oil line.

Heat flows from a hotter object to a colder one, and must overcome certain resistances to its flow. The magnitude of the total resistance depends upon the character of the objects, the distance between them and the character and

Above Ground

—on tanks and other steel surfaces exposed to atmosphere and to gaseous fumes.



Under Ground

—on pipe lines installed in all types of soil—and under extremes of temperature.

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REILLY Protective Coatings fight corrosion on all fronts—above ground and under ground—in all kinds of weather and all types of soil. REILLY Pipe Enamel provides maximum protection for oil, gas and gasoline transportation lines and for all metal under ground or water. It is also used as a lining for steel water conduits and water tanks.

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Once more, the sound design of the Cameron Xmas tree Flow Wing has been demonstrated under extremely high pressure conditions, this time on Gueno No. 3 in the Branch field, Acadia Parish, Louisiana. Tubing flow pressure on this well fluctuates between 6000 and 6400 pounds per square inch, yet the valve section of the Flow Wing opens and closes easily and provides a complete shut-off for choke changing.

The Cameron Flow Wing combines all necessary wing fittings in a single compact unit: (1) An easily operated valve which provides a pressure-tight shutoff for choke changing and obviates the need for a conventional wing valve; (2) A quick change choke, either positive or adjustable; (3) An efficient 2-bolt union which obviates the need for an additional union in the flowline; (4) A bleeder plug to release pressure trapped in the flowline.

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thickness of any other substance separating them. For a flowing oil pipe line the oil is the hot object, the atmosphere the cold one. The resistances are about as follows:

1. Internal resistance of the oil itself to the flow of heat to its outer boundary, appreciable in streamline flow, but overcome in turbulent flow through across-the-stream movements of the oil particles.
2. Resistance of the oil film on the inner wall of the pipe, thicker in streamline flow, reduced perhaps almost to nonexistence in violently turbulent flow.
3. Resistance of a possible dirt film between oil film and pipe wall.
4. Resistance to heat flow into and through steel wall of the pipe, of small magnitude.
5. Resistance of pipe coating, if present, applied for corrosion protection, but also acting as an insulator.
6. Resistance of a possible partial air space, more often on the sides of the pipe, made by expansion and contraction movements of the pipe.
7. Resistance of soil and possibly that of soil surface due to a stagnant film of air.

The values of resistances 1 to 4 have been determined by many tests, and empirical formulas have been developed for calculating them for any given set of conditions. The most reliable data are perhaps in the hands of the manufacturers of heat exchange equipment. Data and formulas are given in many textbooks on heat transmission.

Resistances 5 to 7 have not been thoroughly tested. Only approximate values are available, largely because of innumerable possible variations in the physical conditions.

The reciprocal of the heat flow resistance value of any material is called coefficient of heat transfer "K," expressed in B.t.u. per hour per square foot per degree difference in temperature per inch or foot of thickness. The values per foot of thickness are 1/12th as large as those per inch of thickness.

The most exhaustive mathematical investigation concerning the flow of heat from buried pipe lines was made by F. L. Maker, of Standard Oil Company of California, for an extension course in "The Flow of Viscous Fluids," University of California, Berkeley, California, 1937.

It is not necessary for the calculation of the heat loss in a flowing oil line to determine each resistance separately.

The reciprocal of the sum of all resistance is the overall heat transfer coefficient for the system, and the tests on flowing oil lines mentioned above give the data to evaluate this coefficient "K." The following values for K are average values. Others may have been found by other investigators not mentioned.

Source	Soil condition	K-B.t.u. per sq. ft. per hr. per deg. difference in temperature of oil and temperature of air for thickness of soil cover indicated
The writer	Sandy soil, dry, 24-in. cover	0.25 to 0.40
	Sandy soil, moist, 24-in. cover	0.50 to 0.60
	Sandy soil, soaked, 24-in. cover	1.1 to 1.3
	In river, 60-in. water, 60-in. cover	2 to 2.5
	Sandy soil, dry, 8-in. cover	0.6 to 0.7
	Sandy soil, moist to wet, 8-in. cover	1.2 to 2.4
	Clay soil, dry, 24-in. cover	0.20 to 0.30
	Clay soil, moist, 24-in. cover	0.40 to 0.50
	Clay soil, moist to wet, 24-in. cover	0.60 to 0.90

These "K" (the symbol "U" might be more proper for the coefficient) values are for stable condition of heat loss for bare lines.

Although the heat of the oil is actually lost to the air, the soil temperatures at the depth of the line below the surface can be used in these calculations. Pipe lines are seldom covered less than 24-in. and the temperature at this depth represents an average air temperature in California. In colder climates the lines are laid below the frost line where the temperature is also uniform for weeks or months. It is not necessary to consider the diurnal variations in the atmospheric temperatures. Reference is here made to "Temperature Observations for One Year on Streams of Petroleum Flowing in Mid-Continent Oil Pipe Lines," Bert Martin and W. G. Heltzel, ASME, Tulsa, October, 1930.

An attempt has been made to show the influence of the flow conditions in the pipe line on the K factor, that is, to assign a higher factor to the sections in turbulent flow, reducing it as the flow changes to streamline. This seems unnecessary, for the resistances 1 to 4 are always smaller than 5 to 7. In other words, the condition and character of the soil controls the heat losses, rather than the flow conditions expressed in the Reynolds number. It is recommended that the reader prove this to himself by calculating resistances 1 to 4 for a low velocity of oil flow, using formulas from a textbook on heat transmission. The reciprocal of the sum of these resistances will be higher than any of the K factors given in the tabulation. The flow conditions, however, must be considered if a pipe is submerged in water or oil, or where it is exposed to the air, in which case the heat may be carried away as fast as it reaches the outer wall of the pipe.

C. N. Johnston in his paper "Heat Conductivity of Soil Governs Loss from Heated Oil Lines," *The Petroleum Engineer*, October, 1937, correlates laboratory tests on the heat conductivity of different soils with field tests bringing out the reasons for the different values of the K factors tabulated above for sandy and clay, dry and wet soils. It is proper to state that clay soils are relatively better insulators than sandy soils, largely because air and water move more slowly through them.

Which K factor then shall we use in our calculations? As oil must be moved throughout the year, it will be wise to design the pipe line for winter heat losses. As previously pointed out, the physical conditions along the route of a proposed pipe line are of great importance for the selection of the proper K factor. If the line throughout its length will lie in well drained clay soils, a value of 0.5 to 0.6 might be satisfactory. In sandy soils, possibly submerged during heavy rains, the designer may have to use as high a value as 1.0. Chances are the line will be subjected to different conditions along its route. A careful field inspection and study of the profile are necessary, and the location relative to the hot end of the line of physical aspects, which will result in high heat losses, must be noted. Where the oil is hot, heat losses will be caused that will adversely affect the flow in the whole line. An average value for mixed soils without flooded lows is 0.70 to 0.75 for bare lines for winter conditions in California, along the coast where heavy rains occur. In the interior, where the yearly rainfall averages only 6 in., a value of 0.5 to 0.6 will probably be more correct.

In clay soils the line will usually be protected against corrosion. A 3/8-in. to 1/2-in. thick wrapping of alternate applications of asphalt and felt will reduce K to perhaps 85 per cent of its value for a bare line, a thinner coating proportionally less. A cement coating is less effective as an insulator. ★★★

(Part 3 of Mr. Karge's article will be published in an early issue.)

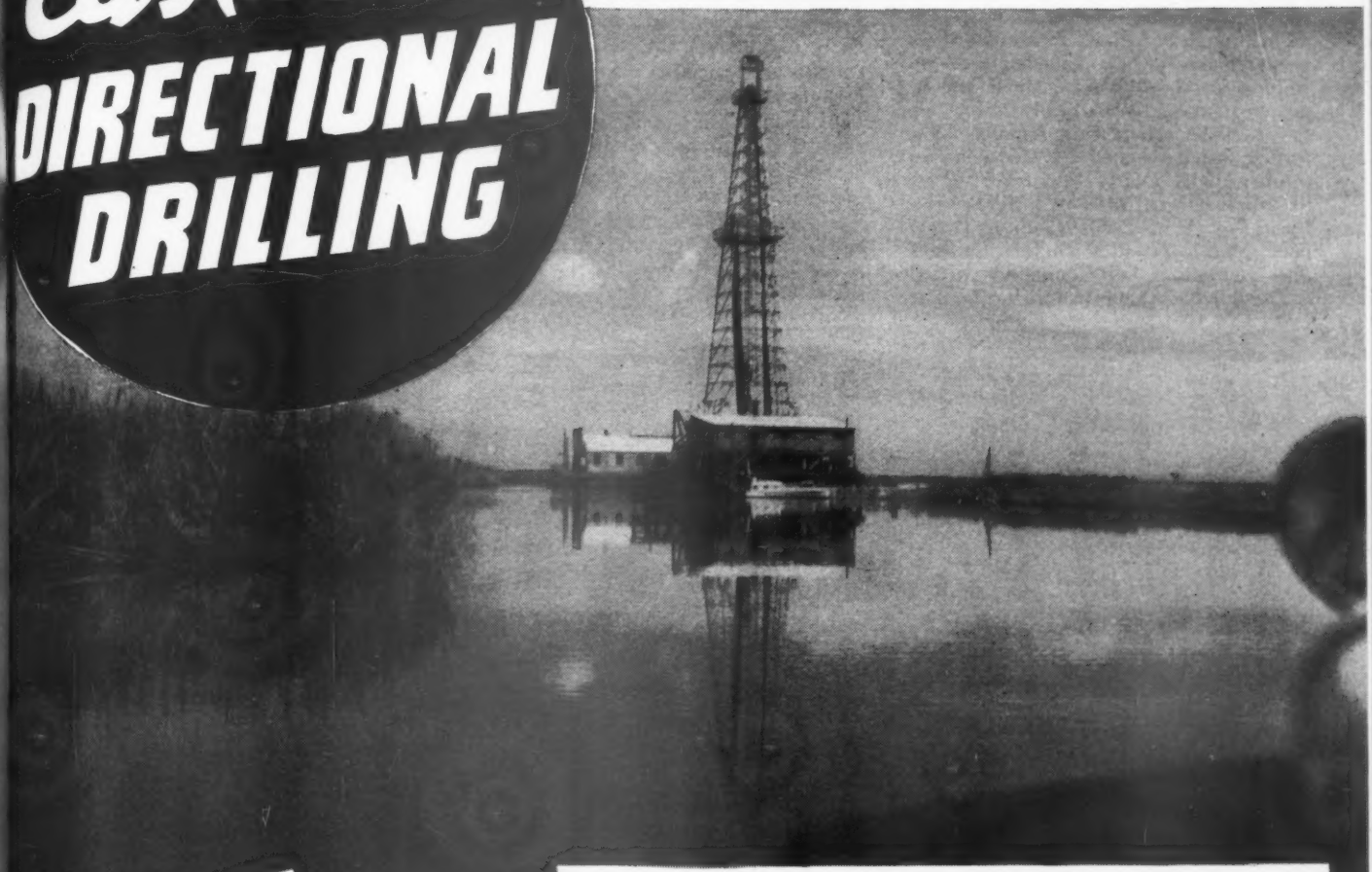
Petroleum makes fog

A man-made fog from petroleum derivatives shot into the air by generators similar to old-fashioned fire engines hid recent Allied maneuvers on Marshall Montgomery's sector of the Rhine front. The product is manufactured by Standard Oil Company of New Jersey in cooperation with the National Research Committee and the army chemical warfare service.

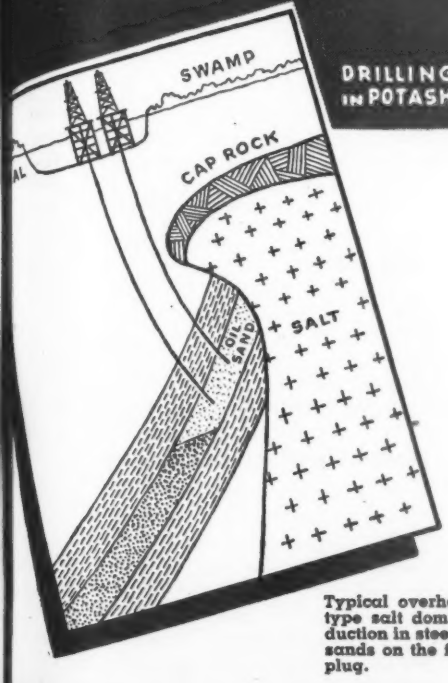
Shot from a generator the way steam hisses from a locomotive safety valve, the smoke can wrap a town in an impenetrable fog. It hits the air at a speed comparable to that of sound, but instead of vanishing as steam does, it remains suspended in the air for a long time thinning out only after it is blown about by air and wind currents, according to the company.

The smoke is made up of billions of droplets microscopic in size. An effective screen of the new smoke can hide a target completely because it throws a reflected glare back at observers, company officials stated. The new product was developed from a principle discovered by Dr. Irving Langmuir, associate director of the General Electric Research Laboratory at Schenectady, New York.

Eastman DIRECTIONAL DRILLING



DRILLING SCENE IN POTASH LA. FIELD



Typical overhanging cap type salt dome with production in steeply dipping sands on the flank of salt plug.

AVOID HAZARD AND EXPENSE OF DRILLING THROUGH CAP ROCK AND SALT

Flank production is more economically and successfully developed by avoiding drilling through salt and the hard and sometimes cavernous cap rock in overhanging cap type salt dome structures.

The derrick is located outside the perimeter of the overhang, the well drilled straight to a point below the overhang, and then directional drilled to the desired position on the producing horizon.

A typical example of this procedure is found in the Potash, Louisiana field, pictured above.

SAVE BY DRILLING MULTIPLE DIRECTIONAL WELLS FROM CANAL.

In swamp areas, such as in the scene above, multiple wells are drilled from a central location, eliminating the dredging of expensive canals to each surface location.

Without obligation, an Eastman engineer will call on you to discuss the Directional Drilling procedure and cost that might apply to your particular problem.

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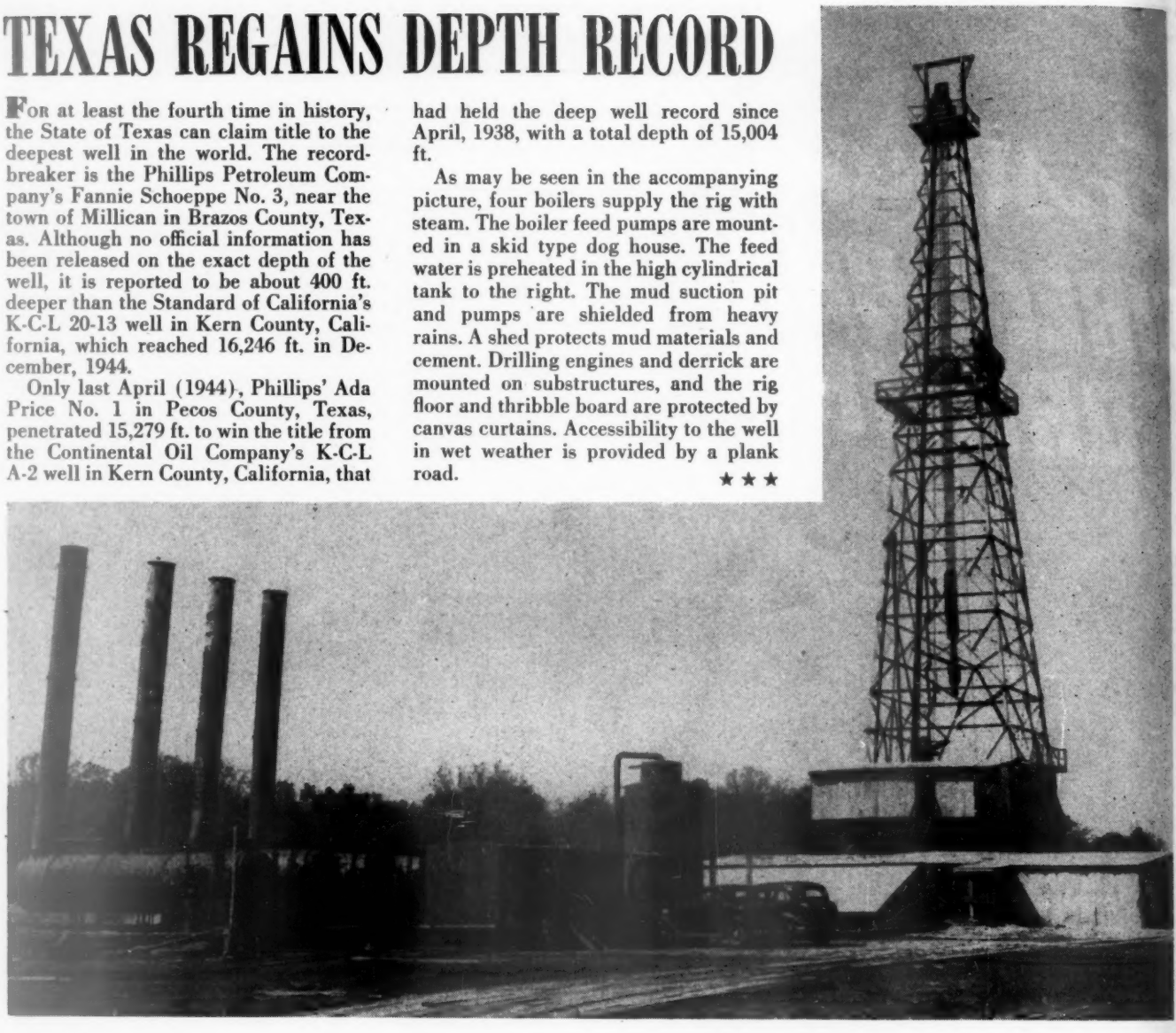
TEXAS REGAINS DEPTH RECORD

For at least the fourth time in history, the State of Texas can claim title to the deepest well in the world. The record-breaker is the Phillips Petroleum Company's Fannie Schoeppe No. 3, near the town of Millican in Brazos County, Texas. Although no official information has been released on the exact depth of the well, it is reported to be about 400 ft. deeper than the Standard of California's K-C-L 20-13 well in Kern County, California, which reached 16,246 ft. in December, 1944.

Only last April (1944), Phillips' Ada Price No. 1 in Pecos County, Texas, penetrated 15,279 ft. to win the title from the Continental Oil Company's K-C-L A-2 well in Kern County, California, that had held the deep well record since April, 1938, with a total depth of 15,004 ft.

As may be seen in the accompanying picture, four boilers supply the rig with steam. The boiler feed pumps are mounted in a skid type dog house. The feed water is preheated in the high cylindrical tank to the right. The mud suction pit and pumps are shielded from heavy rains. A shed protects mud materials and cement. Drilling engines and derrick are mounted on substructures, and the rig floor and thribble board are protected by canvas curtains. Accessibility to the well in wet weather is provided by a plank road.

★ ★ ★



Officers Tulsa Nomads

At the fifth anniversary meeting of Tulsa chapter of Nomads, Shep Miers, vice president, Southwest Supply Company, Tulsa, was elected president of the organization for the current official year. Other officers named at that time are: Vice president, Don Hinderliter, Hinderliter Tool Company; secretary-treasurer, H. M. Cooley, Bethlehem Steel Company; sergeant-at-arms, H. F. Texter, Spang-Chalfant, and regents, Don S. Bowers, W. C. Norris Mfr., Inc., and H. M. Cosgrove, The Purchasing Agents Association of Tulsa.

The retiring president, G. W. (Jack) Walton of the International Derrick and Equipment Company, now located in Dallas, was presented a gold stamped alligator hide pocket wallet by the chapter at the conclusion of his term of office.

Seated, left to right: H. G. Texter, H. M. Cosgrove, Shep Miers, Don S. Bowers, and H. M. Cooley. Standing, left to right, Don Hinderliter, Mitchell Tucker, Henry Bourne, Paul Fitzgerald, and Earle Smith.

Hunt Export Company

Hunt Export Company, a new organization formed April 1 to represent Hunt Tool Company and other well known manufacturers of oil industry equipment in countries outside the United States, has established headquarters at 1945 Saint Bernard Street, Houston, Texas. Six or more manufacturers are, effective with the formation of the company, being represented by it. A branch office, at 19 Rector Street, New York City, is under management of G. M. Stewart.

Running Tour WITH MEN IN THE INDUSTRY

● **W. C. MacMillan,** vice president of Continental Oil Company, has been elected president of Navarro Oil Company. New directors named are **Dan Moran, V. A. Brill, A. K. Tyson, H. D. Henderson, John R. Moran,** and MacMillan. Other officers are Tyson, executive vice president, John R. Moran and **M. H. Shanahan,** vice presidents; **R. L. Bosworth,** secretary-treasurer; **E. F. Harrell,** assistant treasurer; **Miss Helen L. Belk** and **E. E. Clark,** assistant secretaries, and **Miss Mary J. Terry,** assistant transfer agent.

● **Lieutenant Colonel David H. Young,** veteran aviator, recently released from active service, has returned to Pure Oil Company, Chicago, and resumed his position as manager of Pure's aviation marketing department. He joined the company in 1920 after distinguished service in the first World War as a member of the initial group of American flyers assigned to France. Early in 1941 he was recalled to active service with the Army Air Force and has devoted much of his time to experimental flying.

● **M. Lloyd Freese** *was named president of Associated Refineries, Inc., Duncan, Oklahoma, at the annual meeting of the stockholders. Other officers are* **L. B. Simmons,** *chairman of the board;* **B. I. Lubell, R. B. Anderson,** *and* **R. C. Stanford,** *vice presidents;* **Dr. H. B. Alspaugh,** *secretary-treasurer, and* **C. D. Cund** *and* **I. A. Anson,** *assistant secretaries. Directors are Freese, Simmons, Alspaugh, Lubell, Anderson,* **K. M. Moore,** *Stanford,* **W. F. Sims, L. H. Prichard, George H. Burruss, Dean A. McGee,** *and* **P. D. Williams.**

● **Victor Barry,** a member of the foreign trade department of Socony-Vacuum Oil Company, Inc., New York City, has been appointed chief United States petroleum adviser to Great Britain. He was general manager of Socony-Vacuum's central European properties when the war began. Barry succeeds **Clarence E. Meyer,** and will be assisted by **Smith D. Turner.**

● **Fred L. Parker** has been appointed director of fuel and automotive rationing division of OPA succeeding **John G. Neukom** of Chicago. Parker joined OPA in August, 1943. Previously he was associated with the Phillips and Buttorff Manufacturing Company, Nashville, Tennessee.

● **L. T. Potter,** Dallas, Texas, superintendent of production for the Lone Star Gas Company and Lone Star Producing Company, has been assigned as assistant general superintendent of the two companies. Potter joined Lone Star in 1928, and moved to the Dallas office in 1931. He was promoted to chief production engineer in 1939 and to production superintendent in 1941. He is a member of the Dallas Petroleum Club, the American Institute of Mining and Metallurgical Engineers, and is past president of the Dallas Petroleum Engineers Club.

● **Walter E. Wanner** has been appointed superintendent of the Olean, New York, refinery of Socony-Vacuum Oil Company, Inc., and **Benjamin L. Harris**

Walter E. Wanner

Benjamin L. Harris

has been appointed assistant superintendent. Wanner joined the staff of Olean Refinery as assistant to the chief engineer in 1916. Since then he has served the company in Poland, Czechoslovakia, and Italy and for some time with the Petroleum Administration for War. He returned to Olean in July last year and resumed his duties as assistant superintendent. Harris became a laboratory assistant in Socony-Vacuum's Rochester refinery in 1910; in 1918 he was made foreman of the transformer oil department. In 1923 he was transferred to Olean as superintendent of the transformer oil department. In 1930 he became assistant to the superintendent.

● **M. G. Cheney,** Anzac Oil Corporation, Midland, Texas, has been elected president of the American Association of Petroleum Geologists. He succeeds Ira H. Cram, Pure Oil Company, Chicago, Illinois. Other officers elected are **M. Gordon Gulley,** Gulf Oil Corporation, Pittsburgh, Pennsylvania, vice president; **Edward A. Koester,** Darby-Bothwell, Inc., Wichita, Kansas, secretary, and **Gayle Scott,** Texas Christian University, Fort Worth, Texas, editor. **J. P. D. Hull,** Tulsa, Oklahoma, is business manager.

● **W. W. Porter, II,** consulting geologist, member of the Pacific section of the American Association of Petroleum Geologists, has completed temporary appointment with PAW in making California oil and gas reserve estimates. He has resumed private practice in Venezuela, South America, where he serves the Pantepec Oil Company with headquarters in Caracas.

● **Jules E. Toussaint,** general manager of operations in Standard of California's producing department, has been appointed general manager of the department. He joined Standard 23 years ago as construction assistant at the company's Richmond refinery, becoming draftsman, engineer, and assistant chief engineer, in turn. During the latter part of 1943 he earned the title of "One-a-Day" Toussaint as a result of the completion of an average of one well a day by drilling operations under his jurisdiction. Since that time his staff has set an all-time record in the company's drilling history with more than two well completions a day. In 1944 his staff broke the world's well depth record by drilling KCL 20-13 in the Coles Levee field near Taft, California, to 16,246 ft.

● **C. V. Sidwell** has organized The Drilling Mud Company with offices in the Hunt Building, Tulsa, Oklahoma. In addition to distributing drilling mud and other products, including those of the Eastern Clay Products Company, he has a complete consulting service, the Sid-Well Engineering Company, covering all types of drilling and production problems.

● **George S. Tayman** has recently accepted a position with the FPC as natural gas engineer in the division of rates and research, bureau of accounts and finance. For the last two years he has been employed as natural gas engineer in the Office of War Utilities, WPB. Previous to going to Washington in 1943, Tayman was associated with the Union Gas System, Inc., of Independence, Kansas, and one of its predecessor companies, the Owen-Osage Oil and Gas Company, for a period of 22 years.

● **Edwin P. Nelson,** head of the engineering department of Universal Oil Products Company, has been elected a vice president of the company. He joined Universal in 1926.

● **S. B. Irelan** *has been elected to the board of directors of Cities Service Company, according to W. Alton Jones, president. He has been with the company and its affiliates for 36 years and is now president of Cities Service Gas Company. Oklahoma City, Oklahoma. His election fills a vacancy on the board caused by the resignation of* **Valentin R. Garfias** *of Mexico City.*

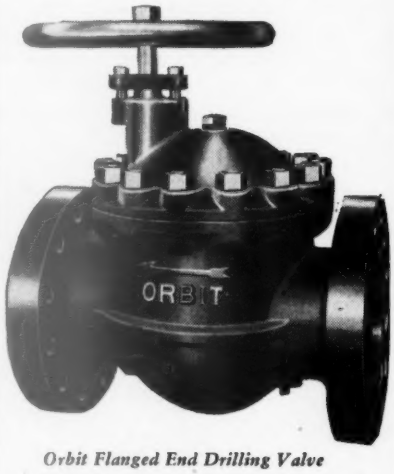
● **T. B. Counselman** has been appointed by The Dorr Company to head the firm's contract engineering division with headquarters in New York City. He will be in charge of the negotiation of contracts and orders for research, development, pilot plant tests, plant and process engineering and design. Counselman comes to his new duties from The Dorr Company's Chicago office, where he was manager of the industrial division.

● **A. G. Bussmann** has been elected vice president in charge of sales of Wickwire Spencer Steel Company, E. P. Holder, president, has announced. In his new position, Bussman will have complete charge of all sales and merchandising operations of Wickwire Spencer and sub-

ORBIT VALVES

DRILLING VALVES ARE QUICK OPENING

ONLY 2½ to 5 TURNS ARE REQUIRED TO FULLY OPEN OR CLOSE THE ORBIT DRILLING VALVE. THE SEATS ARE PROTECTED AGAINST DAMAGE FROM DRILLING TOOLS AND WIRE LINES.



Orbit Flanged End Drilling Valve

ORBIT DRILLING VALVES ARE AVAILABLE IN BOTH FULL OPENING AND NOMINAL OPENING SIZES. WITH FLANGED OR SCREWED ENDS.

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ORBIT VALVE COMPANY

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sidiaries. Previously he was assistant to the president of the company. He will have his offices in the executive offices of Wickwire Spencer in New York City.

● **D. V. Carter,** chief petroleum engineer for Magnolia Petroleum Company, Dallas, Texas, has announced recent additions, promotions, and transfers in the newly reorganized petroleum engineering department as follows: **Dan C. Williams, Jr.** was appointed to the position of assistant chief petroleum engineer; **Jack P. Hays,** appointed chief of the proration and hearings section; **H. M. McClain** appointed chief of the chemical, salt water disposal, and secondary recovery section; **Clyde V. Temple,** appointed chief of the reserves and valuation section, and **Jack S. Woodward,** appointed chief of the drilling and mud control section. **E. C. Patton, Jr.,** was advanced to specialist in charge of reservoir engineering. **Marshall W. Taylor, II,** petroleum engineer was added to the Dallas staff, which includes **John R. Davis,** administrative clerk and **John R. Coombs,** petroleum engineer. **Harve H. Mayfield** was promoted to the post of division engineer for the West Texas division. He will continue to make his headquarters at Kermit, Texas, until offices are available at Midland. **H. E. Schwartz, Jr.,** was advanced to district engineer at Brownfield with **O. E. Van Meter, Jr.,** added to the staff. The Kermit district includes **John W. Adams** and **Felix Martinez,** petroleum engineers, and **J. Frank Dickerson,** division engineering clerk. **Henry Phillip Davis** was promoted to Gulf Coast division engineer with new offices at Houston; **Cecil W. Kelley, Jr.,** was promoted to district petroleum engineer at Alice with **C. R. Claus, G. A. Trimble,** and **William B. Colvin** on the staff as petroleum engineers and **O. H. Winslow** as meterman. **Roland L. Clark** was advanced to district engineer at Vanderbilt. **O. N. Goode** has been appointed district petroleum engineer at Lake Charles, Louisiana, with **Keevil L. Brown** and **Jesse L. White, Jr.,** petroleum engineers. **L. T. Daniel** was appointed division engineer at Shreveport, Louisiana, **J. J. Bresenham, Jr.,** was made district engineer at Jackson, Mississippi, and **James M. Henagan, Jr.,** was transferred from West Texas to Kilgore as petroleum engineer. **C. E. Cochran, Jr.,** was stationed at Salem, Illinois, as petroleum engineer. **Robert A. Armstrong, Jr.,** was transferred from Dallas to Oklahoma City as district petroleum engineer with **H. M. Walker** as petroleum engineer. **W. B. Powers,** formerly district petroleum engineer at Lake Charles, Louisiana, was transferred to the position of assistant superintendent of production in the same district.

Dan C. Williams

● **C. K. McArthur** has been promoted by The Dorr Company to the position of manager of sales covering the United States, Mexico, Canada, Newfoundland, and Alaska. For the last two years he has been manager of the company's metallurgical division. McArthur joined the Dorr Company as sales engineer in 1926. His headquarters continue to be in New York City.

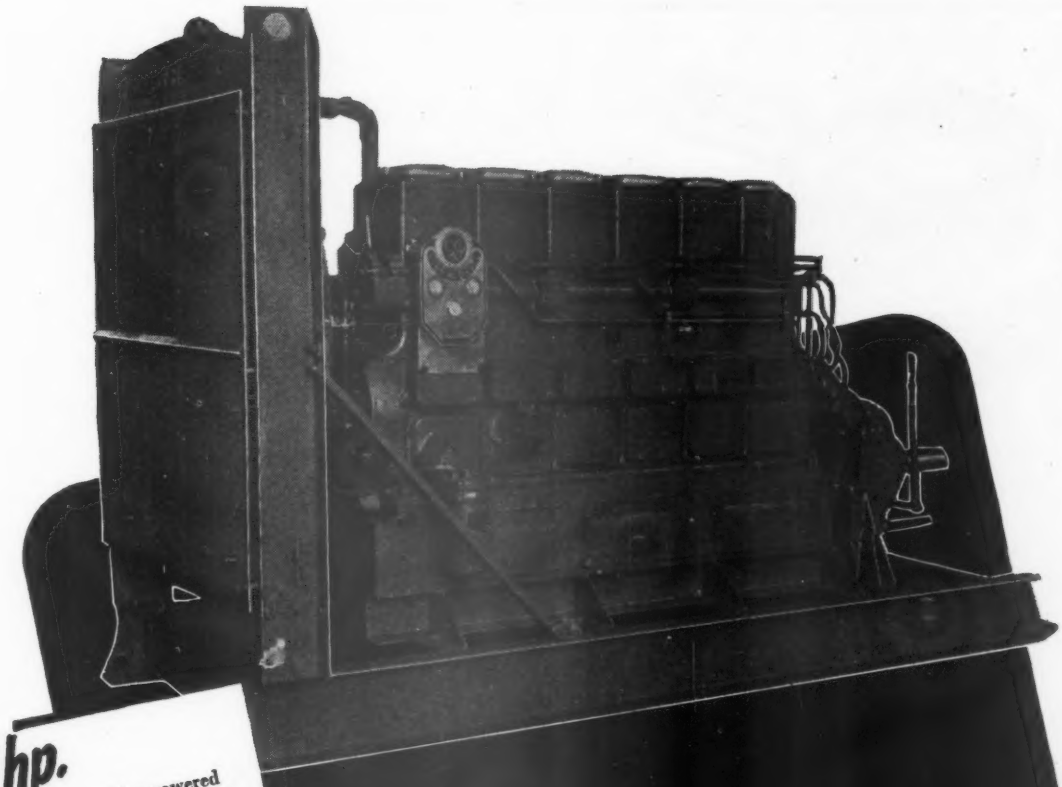
● **William A. Rock** has been appointed resident engineer in the Corpus Christi, Texas, area, for The Foxboro Company, Foxboro, Massachusetts, manufacturers of industrial instruments for measurement and control. Rock brings to his new position vast experience in the instrumentation of oil refineries and gas plants. His mail address is P. O. Box 1956, Corpus Christi. **James A. Tuttle** has joined the staff of engineers attached to the Pittsburgh office of The Foxboro Company. A graduate of MIT, Tuttle spent several years as an engineer with an industrial construction company and later conducted his own business as a manufacturers' representative and engineering consultant. His offices are at 5151 Baum Boulevard, Pittsburgh 24, Pennsylvania.

● **Frank B. Taylor** has joined the staff of Independent Petroleum Association of America as editor of *The Independent Monthly*, C. E. Buchner executive manager has announced. Taylor will have his offices at the national headquarters of the association in the Thompson Building, Tulsa, Oklahoma. In 1936 Taylor went to Tulsa from Texas where he was engaged in natural gas measurement and production for Panhandle Eastern Pipe Line Company. There he became Mid-Continent editor of the *Oil Weekly*, a post that he held until recently when he entered Engineering Sales and Commerce Company as a partner. He is well known as a writer of articles on various phases of the petroleum industry.

● **Weldon B. Hill,** director of public relations of IPAA and managing editor of the organization's publication, *The Independent Monthly*, has resigned to become Gulf Coast editor of the *Oil Weekly*. He resumed his duties on April 1. He was formerly oil editor of the *Houston Post*.

● **Eugene R. Brownscombe** of the Atlantic Refining Company's Dallas research and development department recently presented a paper entitled "Precision in Bottom Hole Pressure Measurements" to members and guests of the East Texas section of AIME. **D. R. Conlon** was co-author of the study.

● **P. E. Lakin,** vice president in charge of marketing and **Dr. E. F. Davis,** vice president and chief consulting geologist of Shell Oil Company, Inc., were elected directors at the recent annual meeting of stockholders. Lakin has been with Shell for 30 years, starting as a clerk in the Seattle offices. He has successfully managed the positions of cashier, chief clerk, and salesman of the Seattle division office, assistant division manager, and vice president in charge of marketing. Dr. Davis joined Shell's exploration de-



450 hp. Rotary rigs powered by compounded Model L Cummins Diesels (rated 225 hp. at 800 rpm. for oil field service) have been in use since 1934. The first installations called for only two Model L engines, producing a total of 450 horsepower.

675 hp. Quick to see the advantages of compounded engines . . . their flexibility and the protection they provided against a shut-down when repairs were needed . . . and also influenced by the trend to deeper drilling, contractors soon went to three Model L's, providing 675 hp.

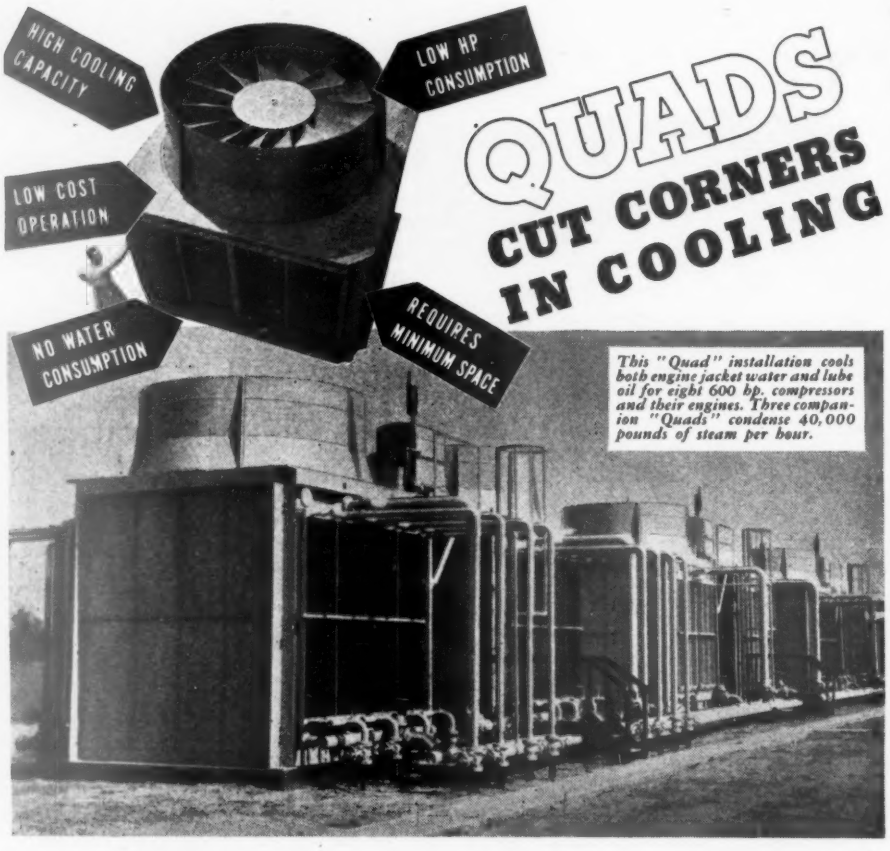
900 hp. With hundreds of three-engine rigs delivering fast, cheap footage in every major field and with wells going ever deeper, equipment manufacturers are now building rigs with four compounded L's on the drawworks (900 hp.) and two compounded L's on the mud pumps (450 hp.) . . . in all, 1350 hp.

RODUCER or dry hole? That's something you can never be sure of until you get there. But you can be sure of this: You will "get there" faster and cheaper with a Cummins Diesel-powered rig. That has been the experience of leading operators and drilling contractors. You can make it your experience, too, by specifying Cummins Dependable Diesels for your rig.

CUMMINS ENGINE CO., INC., Columbus, Ind.

CUMMINS DIESELS

SINCE 1918...PIONEER OF PROFITABLE POWER THROUGH HIGH SPEED DIESELS


HIGH COOLING CAPACITY
LOW HP CONSUMPTION
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REQUIRES MINIMUM SPACE
QUADS
CUT CORNERS IN COOLING
This "Quad" installation cools both engine jacket water and lube oil for eight 600 hp. compressors and their engines. Three companion "Quads" condense 40,000 pounds of steam per hour.

In pioneering the "Quad" (closed cooling system) radiator type cooler and condenser, Young engineers achieved a higher degree of cooling efficiency with lower operating cost. "Quads" have a large capacity and are ideal for installation where requirements are multiple and varied. The vertical exhaust, combined with four sides of cooling, eliminates air re-circulation and the retarding effects of cross-wind currents. All four sides are available for cooling surface. Batteries of Young "Quads" are becoming a familiar sight wherever gas and diesel engines are in use. Let Young engineers supply further data and details without obligation.

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Manufacturers of Oil Coolers • Gas, Gasoline, Diesel Engine Cooling Radiators • Heat Exchangers • Engine Jacket Water Coolers • Unit Heaters • Convectors • Condensers • Evaporators • Air Conditioning Units • Heating Coils • Cooling Coils • and a Complete Line of Aircraft Heat Transfer Equipment.

YOUNG RADIATOR CO. Dept. 285-D RACINE, WISCONSIN, U. S. A.

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THE HAPPY CO., Drawer 770, TULSA 1, OKLA.

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A. R. FLOURNOY CO., 609 S. Grand Ave., LOS ANGELES 14, CALIF.

partment in 1919 and rose to be vice president in charge of geology and production in the Pacific Coast territory. Since last August he has served in his present position.

● **F. W. Butler,** *veteran of 24 years of marketing service with the Standard Oil Company of New Jersey, joined the Carter Oil Company in May, 1944, and has recently been named a director for Carter.*

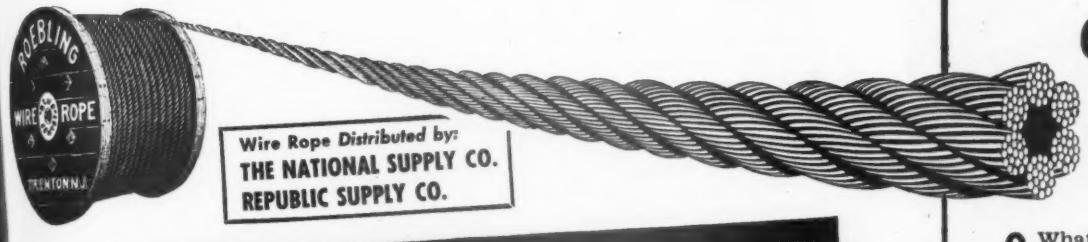
● **Harold "Smoky" Joe Davis** has been appointed as supervisor of fire protection of the Shumaker Naval Ordnance Plant. He is recognized for his work with safety devices from fire in the United States and set up the fire protective program now in operation in Canada. He also is noted in Alaska and the Aleutian Islands for the same type of work. Since the start of the war Davis has directed all his efforts toward building up safety devices in various war projects. Before the war he was consultant in industrial protection at Tulsa, Oklahoma.

● **J. P. Fox,** formerly with the California Company, has been appointed to the position of manager of exploration of the Standard Oil Company of Texas, according to A. J. Cunningham, president. Other changes and promotions among personnel include: **L. W. Orynski,** consulting geologist; **H. L. Burchfiel,** chief geologist; **W. E. Whitcomb,** superintendent of the land and lease division; **C. A. Mix,** regional geologist for the North and East Texas region, offices in Tyler, Texas; **J. F. Gibbs,** regional geologist for the West Texas and New Mexico region, offices in Midland, Texas; **G. H. Stoddard,** regional geologist for the Gulf Coast region, offices in Houston, Texas; **L. M. Cline,** area geologist, offices in Wichita Falls, Texas; **Harvey Hardison,** manager of development and production for the West Texas and New Mexico division, offices in Midland, Texas, and **Joseph Ballanfonte,** manager of development and production for the Gulf Coast and North Texas division, offices in Houston, Texas.

● **Colonel Ernest O. Thompson** *of the Texas Railroad Commission is back on active duty with the army for a temporary assignment believed to deal with oil facilities in liberated Europe. Thompson is a well known authority on oil and gas problems. He helped organize the Interstate Oil Compact Commission and served for three terms as its chairman. He represented the United States at the World Petroleum Congress in 1937.*

● **F. S. Cockburn** has been reappointed field representative for the Allis-Chalmers Manufacturing Company in Peru, according to an announcement by Paul Dietz, export manager for the company's general machinery division. Cockburn was an Allis-Chalmers representative in Peru for a number of years prior to the outbreak of the war. In his new assignment he will work in conjunction with the company's distributors for Peru, the Peruvian Trading Corporation, Ltd. His offices will be at Casilla 2233, Lima.

ROEBLING



Wire Rope Distributed by:
THE NATIONAL SUPPLY CO.
REPUBLIC SUPPLY CO.

QUESTIONS AND ANSWERS

Q What is meant by the designations of 6x7, 6x19, 8x19, and 6x37 rope?

A **Each of the above designates a particular group or classification of wire rope: the 6x7 rope contains 6 strands of 7 wires each, whereas the 6x19 rope contains 6 strands with from 16 to 25 wires per strand. The 8x19 rope contains 8 strands with from 16 to 25 wires per strand, while the 6x37 rope contains 6 strands having from 26 to 46 wires per strand.**

Q How do the above groups or classifications of ropes compare as to abrasion resistance and flexibility?

A **The 6x7, 6x19, 8x19 and 6x37 ropes are rated as listed with respect to abrasion resistance, the 6x7 having the greatest resistance to abrasion. The flexibility of these ropes follow in the same order with the 6x7 having the least flexibility.**

CHOOSE WIRE ROPE FOR THE LONG PULL!

IT'S TOUGH GOING in the oil fields—for men and equipment. And from crown block to tools . . . whether for boring, drilling, hoisting or lowering—efficiency depends on wire rope that has the capacity to *deliver* . . . day in and day out. That's why, when the heat's on to meet stepped-up schedules, you can have confidence in Roebling "Blue Center" Steel Wire Rope . . . and its all-around, built-in *quality*.

Precision-engineered . . . to combine strength and flexibility with fatigue-and-abrasion resistance to best advantage for the job, Roebling "Blue Center" Steel Wire Rope reduces maintenance problems, expensive stoppages . . . and operation costs.

And remember that Roebling, with a century's background of wire specialization, can help you choose the *right rope for your job*. Check with our nearest branch office, and get started on the way to increased output from your rope-rigged equipment. Our wire rope engineers are always at your service.

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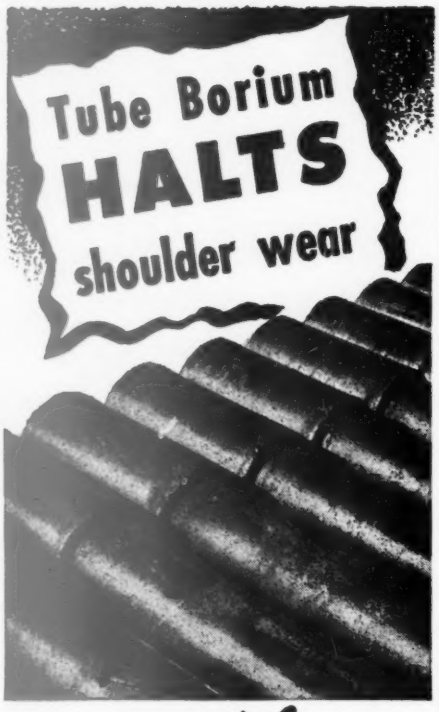
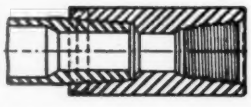


Doubles tool joint life

For fifteen years Tube Borium has been used on drilling bits to increase cutting speeds and drill more out-to-gauge hole. Now you can use this same alloy to greatly prolong the life of your tool joints!

An exceedingly small quantity of Tube Borium welded in a ring around the shoulder not only doubles tool joint life—even under the toughest operating conditions—but maintains over all joint strength and correct elevator contour. Applications are economically made on both new and resleeved joints.

APPLICATION: Accepted method of application is to under-cut new or resleeved joints at the shoulder to form a recess 1/8" deep by 1½" wide. The recess is then filled by welding in with 3/16" Electric Tube Borium to form the wear resistant inlay.



Write for this special Stoody engineering bulletin describing in detail hard-facing procedures on tool joints—no obligation.

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STOODY HARD-FACING ALLOYS
Retard wear... Save Repair

LAUGH WITH BARNEY

First Soldier: No mail for you, eh? I thought your girl said she'd write every day?
Second Soldier: Yeah, sure. But she didn't say to whom.

PRIVATE JONES

With a horde of men I drive a jeep;
With a mob of chaps I try to sleep;
An army accompanies me to mess;
A platoon's around me when I dress;
With a regiment I drill all day;
With a company I eat and play;
Men to left and men to right;
Men around me day and night;
The Army—I can take it, see,
But the thing that murders me,
The irony that stabs my bones
Is this: They call me *Private* Jones!

"I just blew a bunch of soldiers to lunch,"
"Rich guy, eh?"
"Nope. But I'm the bugler."

First German Officer: What do we do now? Retreat?
Second German Officer: Retreat? You must be mad. Germans never retreat. We must advance in the direction from which we came.

"Why ain't you going with Mary no more?"
"Well, she wasn't pretty, didn't have no money, and married Joe. So I just took the advice of my friends and dropped her."

"I see by the paper that nine sergeants and one private were hurt in a wreck."
"Poor chap."

"I'm telling you for the last time that you can't kiss me."
"Fine! I knew you would weaken sooner or later."

Supply Officer: That stew had a funny taste. Who's responsible?
Mess Sergeant: Well, sir, I believe the assistant cook had a hand in it.

A Boston-born junior executive had been courting a show girl for several years and at last decided to marry her. He took his bride to Boston to meet his somewhat starchy folks. They liked her. Everything went along delightfully until his mother inquired hopefully:
"New York, I hear, is terribly crowded. Have you found a place to live?"
Whereupon the girl, in the innocence of her heart, answered promptly: "Oh, that's no problem at all. We're going to keep the darling apartment we've had all along."

A psychiatrist was examining a selectee.
Psychiatrist: What's your occupation?
Selectee: I'm a gag writer for radio.
Psychiatrist: Let's see you invent a gag.
Selectee (rising slowly, goes to the door and looks down at the long line of other selectees): O.K. you guys can go home now, the job's taken.

The Army cook had just whipped up orders of fried eggs for a hungry mob of soldiers. Wearied by his herculean efforts, he sat down, yawned, lit a black cigar and wrote a letter to his sweetheart.
"Darling," he began, "for the past three hours shells have been bursting all around me."

Blonde: I'll stand on my principles or bust.
"Never mind, gorgeous, just stand on your principles."

"In this bottle I have peroxide, which makes blondes, and in this one I have dye that makes brunettes."
"And what is that stuff in the third bottle?"
"Gin, which makes both!"

"I think twice before I let anyone kiss me."
"Oh, well, all right, but make it snappy!"

Army Doctor: Who's on the sick list today?
Orderly: Lieutenant Busby complains of pains in the abdomen and Private Smith has a belly ache.

Old Lady: You don't smoke cigarettes, do you, soldier?
Soldier: No, ma'am, but I can let you have a chaw of terbaccer.

"What do they mean by the 'eternal war between blondes and brunettes'?"
"Chemical warfare."

"We can't have any fun this evening. All I have in my pocket is some small change."
"Well, what do you think it takes to send my kid brother to the movie? A five-dollar bill?"

Young Millionaire (in night club): I'm having a triple Scotch and soda. What will you have, Blondie?
Blondie: A husband, if it affects you the way I think it will.

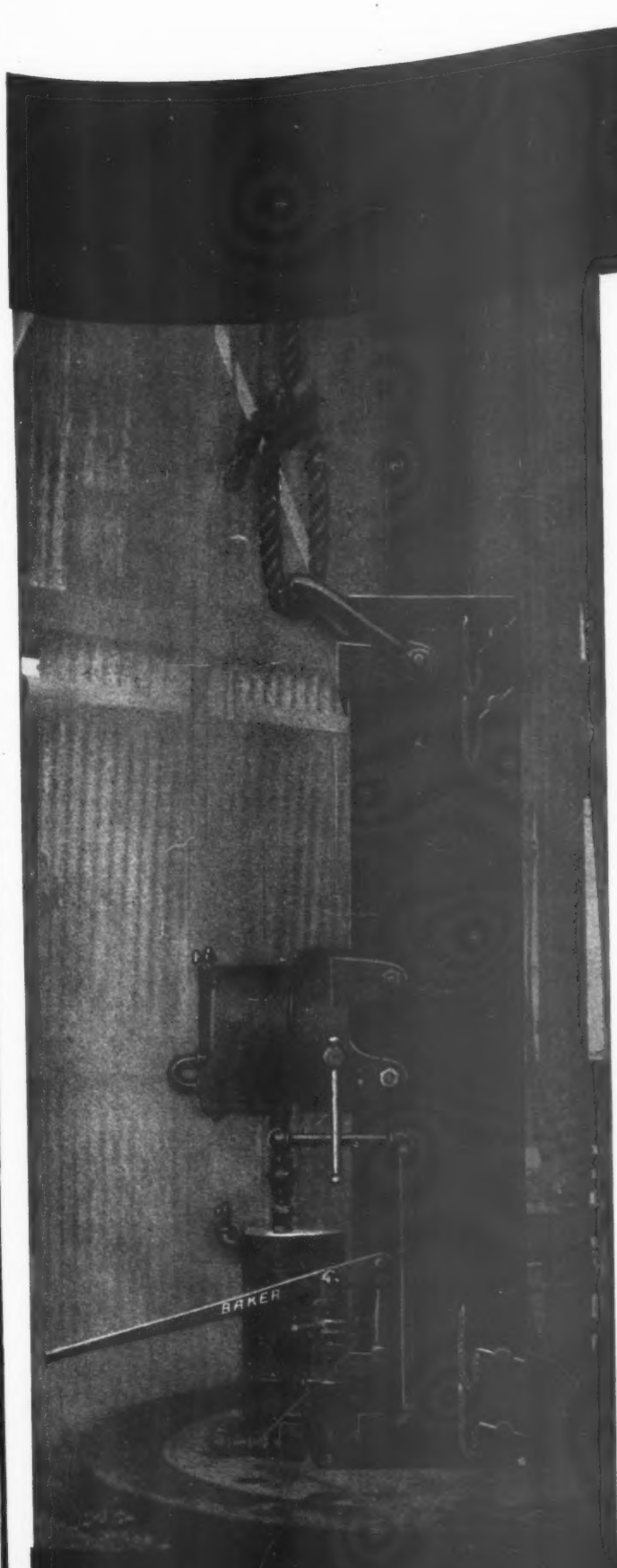
Phil: I understand that a wife is a great help to a man.
Bill: Yes, she'll stand by you in all the troubles that you wouldn't have had if you hadn't married her.

At the depot:
"There ain't no hotel here, miss, but you can sleep with the station agent."
"Sir!" she exclaimed indignantly, "I'll have you understand that I'm a lady!"
"Oh, that's all right," drawled the old man. "So's the station agent."

"Well, waiter, that was a tip-top dinner. You know what that means, don't you?"
"Yes, sah—it's one dat you top off with a tip."

An Irishman went into a church and fell asleep. The sexton aroused him and told him he was closing up. "What do you mean?" asked the Irishman. "The cathedral never closes."
"This is not the cathedral," exclaimed the sexton. "This is the Presbyterian Church." The Irishman looked around. On the walls were paintings of the apostles. "Isn't that St. Luke over there?" he inquired.
"Yes."
"And St. Thomas further on?"
"Yes."
"Since when did they become Presbyterians?"

"Then an explosion tore up Main Street."
"Goodness! And what did you do?"
"Tore up a side street."



in 1945

. . . we are arranging to produce a limited quantity of Baker Portable Hydraulic Kelly and Pipe Straighteners. This unit has been in great demand for *conserving* the life of Kellys and drill pipe, and for *salvaging* all types of tubular goods. If you are interested in securing one of these handy, efficient devices, we suggest that your order be placed promptly with the Baker office most convenient to you.

- Straightens Kelly, Drill Collar or Drill Pipe as it hangs suspended in the derrick.
- Weighing only 1,400 pounds complete, it can be transported easily on a small "pick-up" truck, and lifted on the rotary table by means of the catline.
- Straightens Kelly or Drill Pipe *at the rig*, the proper place to straighten bends caused in service, during transportation, or when laid down or picked up.
- Ideal for use in foreign fields or in isolated locations, where transporting the Kelly or drill pipe from rig to shop often is a serious and expensive procedure.
- Compact in size, but handles pipe up to 8¾-inch diameter.

BAKER OIL TOOLS, INC.

Houston - LOS ANGELES - New York

API district officers

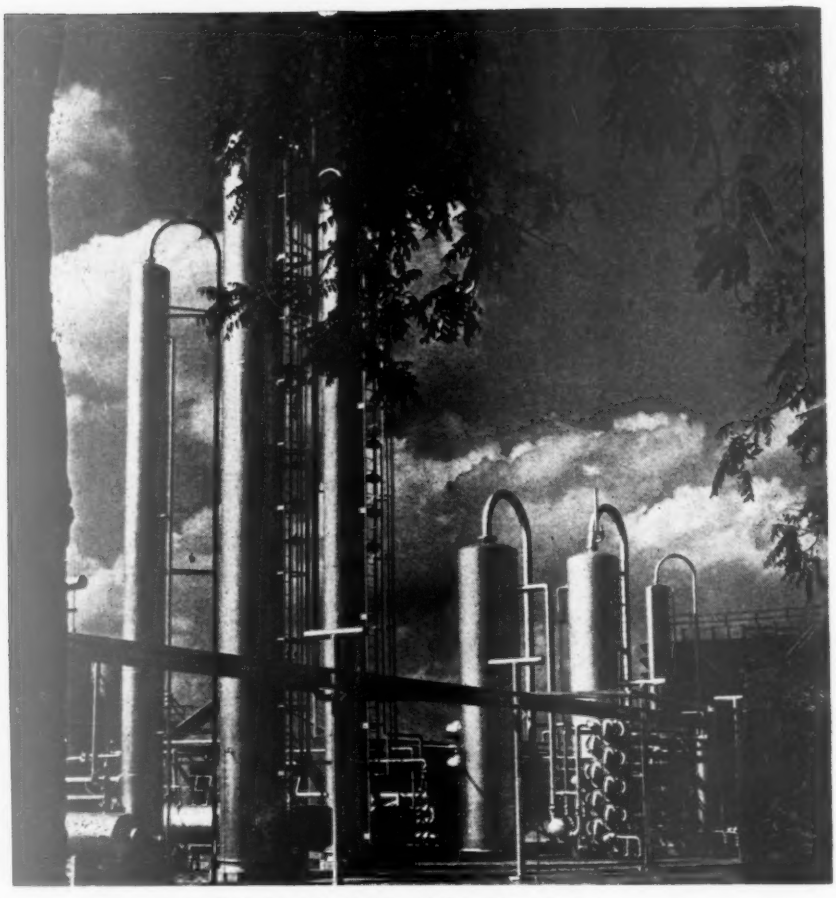
The American Petroleum Institute Pacific Coast district Division of Production at the spring meeting March 29 elected the following officers for 1945-46:

Chairman, B. P. Kantzer, Union Oil Company of California; vice chairman, Los Angeles Basin district, Lot Bowen, Signal Oil and Gas Company; vice chairman, San Joaquin Valley district, Paul E. Lehr, Shell Oil Company, Inc.; vice chairman, Coastal district, F. W. Hertel, Tide Water Associated Oil Company; secretary-treasurer, W. G. Corey, Lacy Oil Tool Company, and assistant secretary, Mrs. Elsie M. Edmiston, American Petroleum Institute.

The advisory committee consists of the following: George O. Suman*, chairman, Tide Water Associated Oil Co.; Paul Andrews, Signal Oil and Gas Company; H. K. Armstrong, consultant; L. L. Aubert, Bankline Oil Company; V. P. Baker, Independent Exploration Company; Carlton Beal, Richfield Oil Corporation; A. H. Bell, Continental Oil Company; L. A. Cranson, Honolulu Oil Corporation; L. C. Decius, Tide Water Associated Oil Company; J. F. Dodge, University of Southern California; R. E. Foss, Barnsdall Oil Company; W. F. Goertz, Axelson Manufacturing Company; J. E. Gosline, Standard Oil Company of California; E. B. Hall, E. B. Hall and Company; R. P. Huggins, Western Gulf Oil Company; D. S. Kilgour, Western Oil and Gas Association; W. N. Lacey, California Institute of Technology; E. W. Masters, Shell Oil Company, Inc.; E. H. McCollough, Amerada Petroleum Corporation; R. D. Montgomery, Richfield Oil Corporation; R. C. Patterson, Belridge Oil Company; E. K. Parks, consultant; J. R. Pemberton, consultant; E. E. Pyles, chairman, District 5, Production Committee; B. H. Robinson, General Petroleum Corporation; N. A. Rousselot, Seaboard Oil Corporation; J. B. Sutherland, The Ohio Oil Company; R. C. Templeton, consultant; J. T. Wood, Jr., The Texas Company, and H. T. Wyatt, Union Pacific Railroad.

*Ex-officio.

TULSA TYPE Natural Gasoline AND Refining Equipment Built RIGHT!



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American Steel Derricks

TULSA BOILER & MACHINERY CO.

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Joins Davis-Dyke

Davis-Dyke and Company, advertising specialists, Houston, Texas, announce the appointment of Spencer W. Robinson to their advertising staff. Robinson, formerly vice president and editorial director of the Gulf Publishing Company's oil publications, recently resigned as director of public relations for the Petroleum Administration for War in Washington.

S. W. Robinson

Robinson is widely known in the petroleum industry through his editorial work over a period of 25 years, and is prominently identified with the development of several important works in that field. Starting his career in the oil industry at the time of the Goose Creek boom of 1918 Robinson has "been through" all the important oil discoveries since that time. His editorial experience has carried him into all phases of oil industry literature and for four years he served as advertising and sales manager of the publications he represented.

In recognition of his broad knowledge and background in the oil industry, Robinson was "drafted" by Petroleum Administrator Harold L. Ickes early in 1944 to serve as director of public relations for PAW. In this capacity he directed the highly important wartime job of keeping both the oil industry and the general public informed regarding petroleum supplies and the activities of this unique petroleum industry war team.

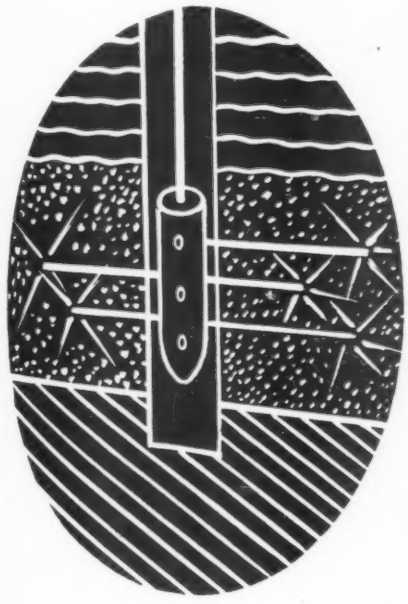
In addition to his work in the oil industry, Robinson has been active in civic affairs in his home town of Houston and was associated with a group that organized and developed the council-manager form of government for the city. Later Robinson accepted an invitation to stand for city councilman and was elected to that position the latter part of 1942. He resigned from the council after 15 months' service to accept the PAW appointment in Washington.

With Davis-Dyke and Company, Robinson will continue his association with the oil industry through his contact with the large number of oil equipment and service companies served by his firm.

Well treating method

Well Explosives, Inc., was recently organized by W. H. Thompson of Fort Worth, Texas, to offer a method of treating stripper wells for the purpose of increasing the ratio of recoverable oil. The method may also be used successfully in new wells where a tight sand condition prevails. The company will operate under a basic patent granted to James Lewis Foster of Wichita Falls, Texas, a petroleum engineer now serving with the armed forces.

The patent grants broad protective rights covering the delayed explosion of a gun-perforation projectile, officials of the company assert. This approach to increasing the amount of recoverable oil is especially interesting in view of the recently developed explosives having many times the potency of TNT. In this



way a relatively small projectile can travel a predetermined distance back into the producing section and then detonate with great power.

The patent covers this method of treating oil wells, whether the operation is performed by a single projectile or by multiple fired projectiles that subsequently explode into the surrounding formation. Wells Explosives, Inc., P. O. Box 938, Fort Worth 9, Texas, has not announced definite plans for marketing the service. A gun to handle the projectile is also included in the patent, but Thompson states that several guns now on the market can be used efficiently.

CHIEF ENGINEER: To supervise engineering, design estimating, and processing of oilfield equipment, welding, and grey iron foundry work. Plant employs 150 people in community of 25,000 in central Ohio. State complete details on experience, education, age, marital status, draft status, and salary expected. Reply to Box 26, c/o The Petroleum Engineer, P. O. Box 1589, Dallas, Texas.

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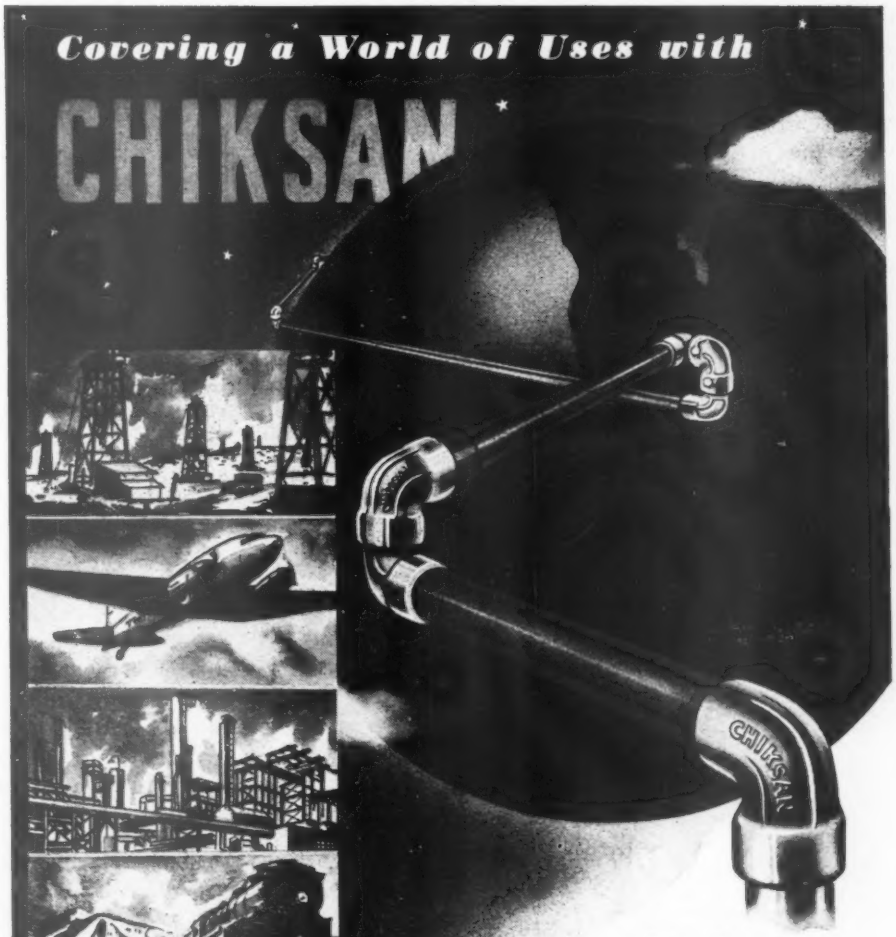

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In new offices

New centralized administrative offices of Dresser Industries, Inc., formerly of Bradford, Pennsylvania, were opened March 19 at 1130 Terminal Tower, Cleveland, according to H. N. Mallon, president. Planned to provide the latest and most efficient business facilities for the company's personnel, the new offices will also reduce executive travel time to the company's 18 different plants by providing a more central location for the company's headquarters.

Dresser Industries, Inc., parent corporation of 13 member companies, has laid out its 5800 sq. ft. of space in the Terminal Tower to provide modern conference space, reception room, and executive suites, in addition to 14 offices for the accommodation of its staff. Unusual construction and lighting features have been installed to add to the working efficiency of the personnel.

Dresser Industries member companies include Bryant Heater Company, Cleveland; Dresser Manufacturing Division, Bradford, Pennsylvania; Clark Bros. Co., Inc., Olean, New York; Pacific Pumps, Inc., Huntington Park, California; International Derrick and Equipment Company, Columbus, Marietta, and Delaware, Ohio, Beaumont, Texas, and Torrance, California; Stacey Bros. Gas Construction Company, Cincinnati; Roots-Connersville Blower Corporation, Connersville, Indiana; Dresser Manufacturing Company, Ltd., Toronto; Bovaird and Seyfang Manufacturing Company, Bradford, and Van der Horst Corporation of America, Olean, New York and Cleveland, Ohio.

Newest members of the Dresser Industries group as recently announced are Payne Furnace Company, and Kobe, Inc., both of California. Another company, Day and Night Manufacturing Company, also of California, is now in the process of acquisition.

B. D. Balthis dies

The death of B. Douglass Balthis, 47, president of Natural Gas Equipment, Inc., as the result of a heart attack, removes another well known figure in the field of industry and civic life in Southern California.

Death occurred at the family residence, 1536 Bel Air Drive, Glendale, California. The deceased was a native of Huntsville, Mississippi, went to high school at Glendale, and later attended Stanford University. In World War I he served as a member of the famous Rainbow Division.

A brother, Frank S. Balthis, Jr., is district director of the Office of Price Administration, and a son, 1st Lieut. Douglass Balthis, Jr., is serving in Italy with the Air Force as pilot of a P-38.

Balthis is survived by his wife, Esther Sinclair Balthis; a daughter, Mrs. Barbara Balthis Fitzpatrick, and a brother, William Balthis, police commissioner of Maui, T. H., and an officer of the Bank of Hawaii, and his brother in Los Angeles and son in active service, mentioned above.

Elliott Company elects

Creation of the office of engineering vice president and additional responsibilities for other executive officers of Elliott Company, Jeannette, Pennsylvania, were announced by Grant B. Shipley, board chairman and president, following the company's annual meeting.

W. A. Elliott, vice president in charge of sales, was elected executive vice president. Ronald B. Smith, manager of engineering research and development, was elected vice president in charge of engineering. M. G. Shevchik, secretary, was elected secretary and treasurer.

Elliott executive officers re-elected include: Grant B. Shipley, board chairman and president; F. H. Stohr, assistant to the president; R. W. Owens, vice president in charge of manufacturing, and Dundas Peacock, controller. Present directors were re-elected by the shareholders.

F. W. Dohring, general sales manager, was given added responsibilities as assistant to the executive vice president.

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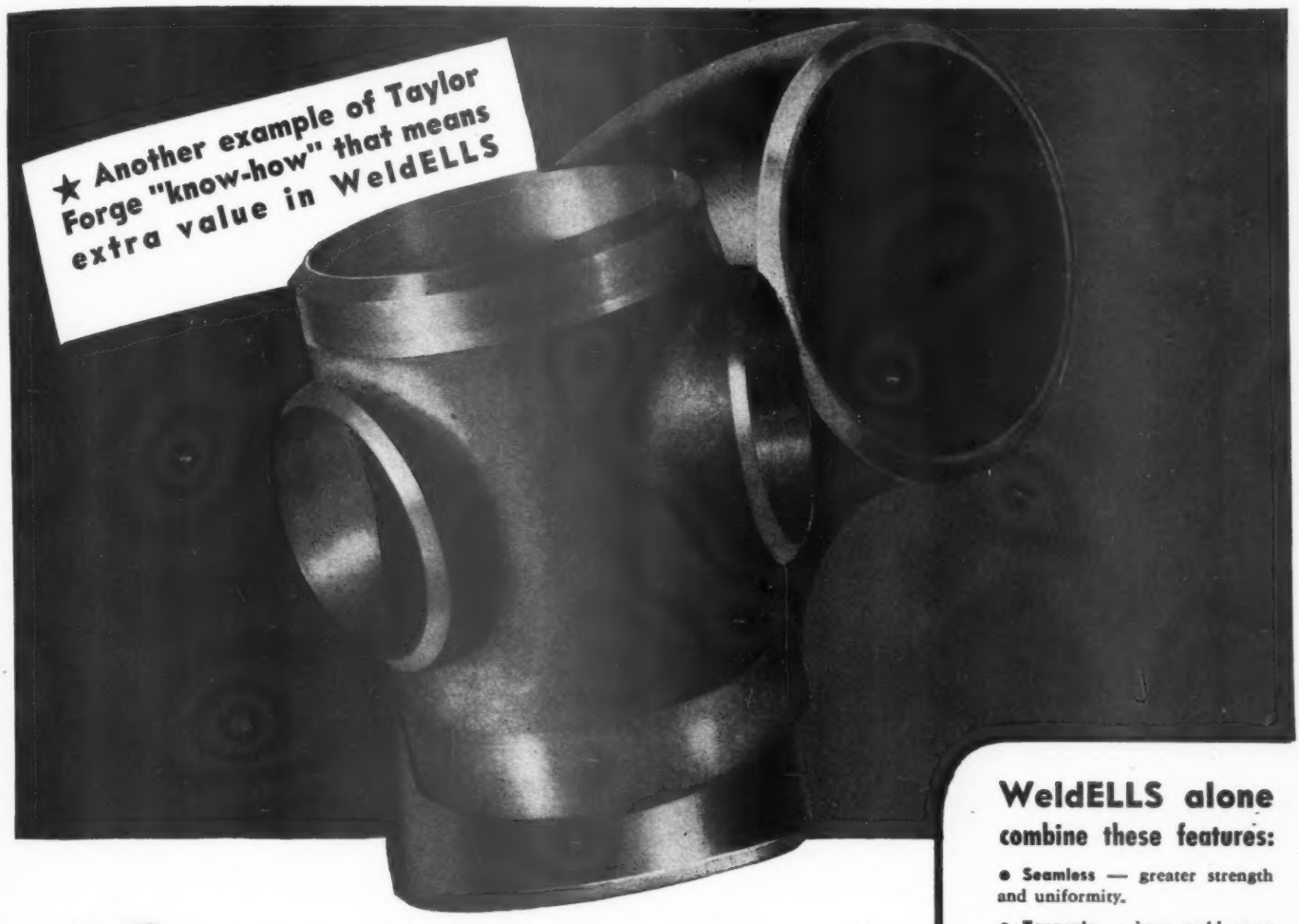

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★ *As far as we know this is the only welding fitting of its kind. We forged it seamless in carbon-moly—10" pipe size in the run with .605" wall, and 7" in each branch with .429" walls.*

It is neither "fish nor fowl"—not a side outlet tee because the included angle between the outlets is more than 90°, and it could hardly be called a cross. It's just one of the many once-in-a-life-time forging problems that have been assigned to us by engineers who have found that we do things with hot metal that no one else does.

YOU say you don't ever expect to run into a condition calling for a fitting like this? Probably not. But you do use standard welding fittings and this special fitting has a vital bearing on their selection. We have cited this and many other special forging problems because the "know-how" accumulated in solving them is the vital ingredient in every fitting in our regular production line of WeldELLS and other Taylor Forge fittings for pipe welding.

Every one of these many special problems has added something to our knowledge in a field where knowledge is all important. What else could explain the unduplicated combination of features found in WeldELLS . . . features like extra metal properly distributed where stresses are greatest . . . tangents . . . extremely accurate dimensions . . . and the many other features listed opposite?

What else, indeed, could have developed fittings of which it can be said:

WeldELLS have everything

WeldELLS alone combine these features:

- **Seamless** — greater strength and uniformity.
- **Tangents** — keep weld away from zone of highest stress—simplify lining up.
- **Precision quarter-marked ends**—simplify layout and help insure accuracy.
- **Selective reinforcement**—provides uniform strength.
- **Permanent and complete identification marking**—saves time and eliminates errors in shop and field.
- **Wall thickness never less than specification minimum** — assures full strength and long life.
- **Machine tool beveled ends** — provides best welding surface and accurate bevel and land.
- **The most complete line of Welding Fittings and Forged Steel Flanges in the World**—insures complete service and undivided responsibility.

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Field reclassification

What is expected to be a valuable contribution to the California oil industry is the work that has been started by the classification committee of the Pacific Section of the American Association of Petroleum Geologists.

This committee of geologists, at the suggestion of various oil industry groups, has undertaken a reclassification and, when desirable, a renaming of California oil fields, oil pools, and oil areas.

This committee is at present charged with the duties of formulating appropriate names for the new discoveries of oil and gas and is now cooperating with both the division of oil and gas and the conservation committee of California Oil Producers in this capacity. In addition, the commitee gathers statistics on wildcat drilling.

The members of the classification commitee plan to interview oil operators, state oil and gas engineers, and others interested in this problem of reclassification and will endeavor to establish a system of classification and names that will avoid confusion and provide a more useful set of statistics for compiling and reporting data on California oil fields.

Members of the committee, their addresses, and the territories assigned to them follow: Frank S. Parker, chairman, Petroleum Administration for War, 758 Subway Terminal Building, Los Angeles 13, Los Angeles Basin; Harvey Lee, Union Oil Company, Los Angeles 14, Coastal District; Robert W. Burger, The Texas Company, Bakersfield, West Side of San Joaquin Valley and Northern California; Mason L. Hill, Richfield Oil Corporation, Bakersfield, Central Valley and East Side Districts.

The names now in use for oil fields and oil areas just "grew up" with the individual localities, according to Frank S. Parker, chairman of the committee. Different organizations use different names and divide up oil fields in a different manner. He cited the example of the term Sunset, which has been used for three separate fields in California, namely, the area near Taft, a portion of the Mt. Poso field northeast of Bakersfield, and a small field now abandoned in Hopper Canyon in Ventura County.

Parker said committee members will welcome any discussion and cooperation from oil operators and all other interested persons in their respective districts.

At present the committee is formulating terms that will more closely define the words field, area, and pool.

Compact to meet in June

Observance of ODT orders relative to conventions was pledged by the Interstate Oil Compact Commission following a meeting of its executive committee in Oklahoma City recently, it is announced by Earl Foster, commission secretary.

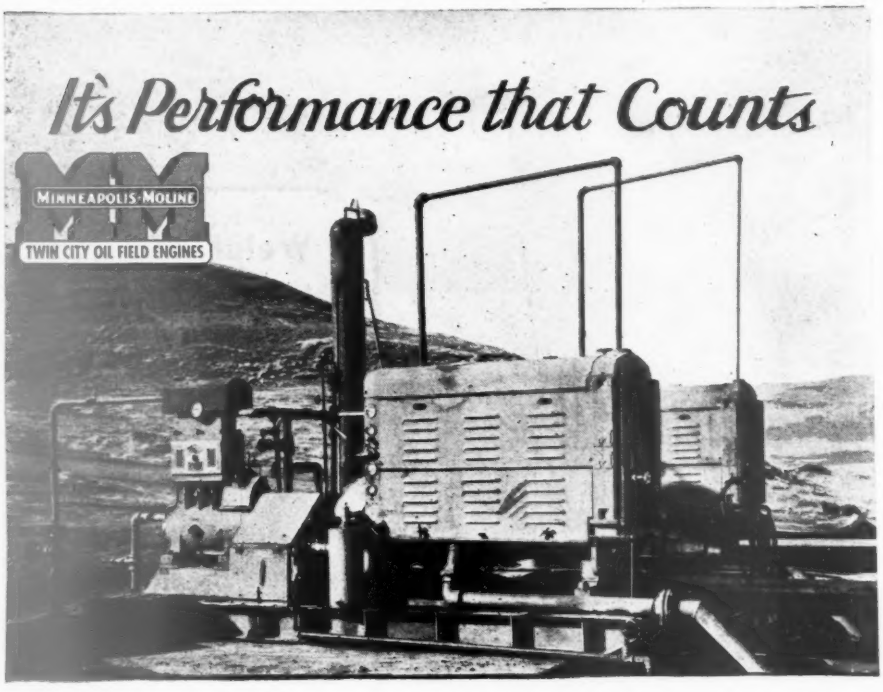
"The executive committee voted to streamline future quarterly meetings of the commission to meet in spirit and practice the emergency orders of the Office of Defense Transportation limiting the size of meetings and conventions," Foster said. "Although two more states have recently joined the Compact, Montana and West Virginia, and the work of the commission has greatly increased in volume and importance since the beginning of the war, the Interstate Oil Compact Commission will continue to exert its every influence in furthering the war effort."

The next quarterly meeting of the commission will be held in Oklahoma City, headquarters of the commission, on June 15 and 16. Only officials of the commission, its committees, and authorities on the subjects to be considered at the meeting will be invited to participate in the two-day session.

Eastern representative

W. R. Wood, vice president in charge of the Gas Processes Division of The Girdler Corporation, has announced the appointment of J. D. Gordon as eastern representative, with offices at 150 Broadway, New York. He assumed his new duties April 1.

Gordon received his B. S. degree in chemical engineering from Georgia Tech in 1936, and joined the staff of the Swann Chemical Company, Birmingham, Alabama, the same year. He became associated with The Girdler Corporation's Gas Processes Division in 1939.



The *value received* from an oil field engine *is not measured* so much by its *cost* but rather by the *performance* that it gives—an engine that will operate 24 hours per day, day in and day out giving low cost, efficient performance free of mechanical breakdown is the one that *stands out* in the final analysis. *25,000 hours* of *continuous service* with stops only for oiling and greasing *is not uncommon* with *MM Oil Field Engines*. All the low cost, high performance features are *"built-in"* on *every* MM Oil Field Engine—that is why we say when *you* buy an Oil Field Engine *"It's Performance that Counts"*.

MM Oil Field Engines are built in 8 sizes to fit most every oil field application:

165-4A	3⅝x4, 4 cyl.	CUA	4¼x5, 6 cyl.
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KUA	4¼x5, 4 cyl.	MEU	8x9, 4 cyl.
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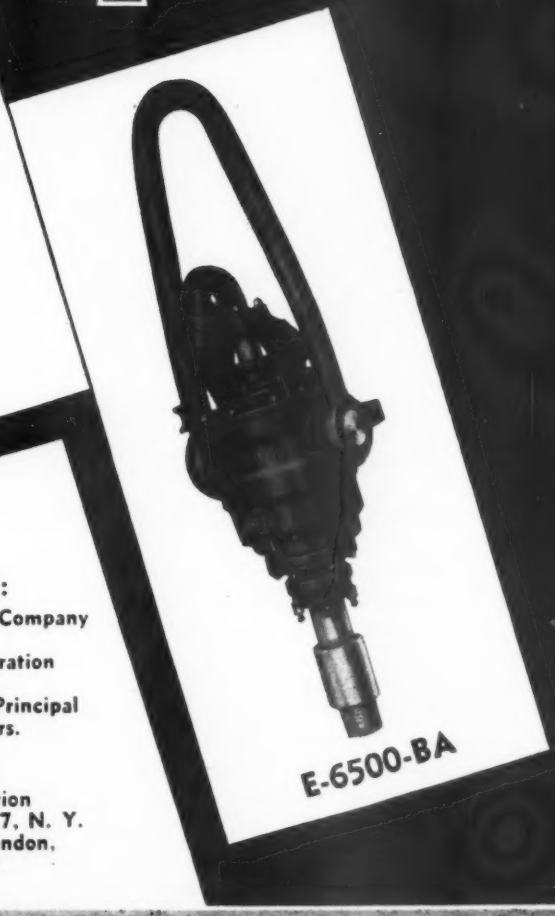

E-6000-BA	E-6500-BA	E-7000
Load Rating at 100 R.P.M.		
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Recommended Drilling Depth		
Up to 6000 Ft.	Up to 8500 Ft.	Up to 15000 Ft.

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Designed for the heaviest loads, the toughest conditions, the deepest wells, Wheland Swivels have established many enviable records. Carefully engineered in every detail, they are precision built of the finest materials by skilled workmen. Construction, bearings and lubrication method combine to insure perfect alignment and long life. All sizes designed for Bearings to run in an Oil Bath with Spring Loaded, Lubricated Wash Pipe Packing.

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Purchasing agent

John J. Heffernan has been appointed purchasing agent of the Universal Atlas Cement Company and the Atlas Lumnite Cement Company, United States Steel Corporation Subsidiaries, effective April 1.

He succeeds the late Richard B. Hynes who died on March 21. Formerly secretary of Universal Atlas and of Atlas Lumnite, Heffernan has served for the past two years as assistant purchasing agent of both companies.

After active service during the first World War, Heffernan was employed in various capacities in New York and Boston. In 1925 he joined the Atlas Portland Cement Company in New York where he was employed in the secretary's office. When Atlas and Universal were combined in 1930 with headquarters in Chicago Heffernan transferred to that city and subsequently became assistant secretary of Universal Atlas and Atlas Lumnite in Chicago.

After the removal of the company headquarters to New York he became secretary and later became assistant purchasing agent of both companies.

Universal Atlas has a cement plant and Southwest sales office at Waco, Texas.

Val Link to Dallas

After eight years as sales engineer at the Shreveport office of Westcott and Greis, division of American Meter Company, Val Link is now serving in the same capacity at that company's Dallas, Texas, branch.

A graduate of St. Mary's College at San Antonio, Link began his career with the United Gas System. When he left that organization in 1937 he was in

charge of the measurement department of the Laredo-Bruni district.

In addition to his engineering background and years of practical experience, his excellent knowledge of Spanish has enabled him to be of special service to companies operating in Mexico.

S. L. Myers promoted

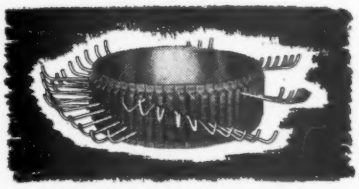
S. L. ("Sid") Myers, formerly vice president in charge of export sales for LaPlant-Choate Manufacturing Company, Inc., of Cedar Rapids, Iowa, has been appointed vice president and general sales manager, succeeding H. H. Buchanan, resigned.

S. L. Myers

Myers has served LaPlant-Choate in various capacities for more than 22 years, having started as a helper in the machine shop in 1923. After working in the shop, he served as traffic manager, purchasing agent and export sales manager, in addition to being responsible for government sales. On August 31, 1943, he was advanced to the position of vice president, in which capacity he has continued to serve until his recent appointment as general sales manager.

...and you can't expect 3 or 4 B and W Wall Cleaning Guides to insure you a good cement job.

Cleaning the walls of the hole for cementing is a BIG job — don't ever underestimate it. Put on enough B and W Guides when you run the casing, and move the casing while you circulate and cement. That way, the cement makes a good bond with the cleaned formation . . . the casing is centered in a solid, fluid-tight wall of uniform thickness. No channeling — no fluid migration — no salt water — no recementing!



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Must be capable of assuming responsibility of designing and estimating. Permanent position available with progressive oil tool company in Houston. Our employees have been informed of this advertisement. Address reply to Box 27, % The Petroleum Engineer, Dallas.

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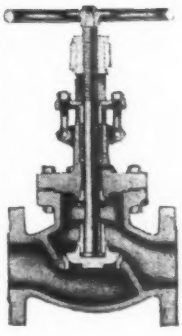
(1) *OIC valves*

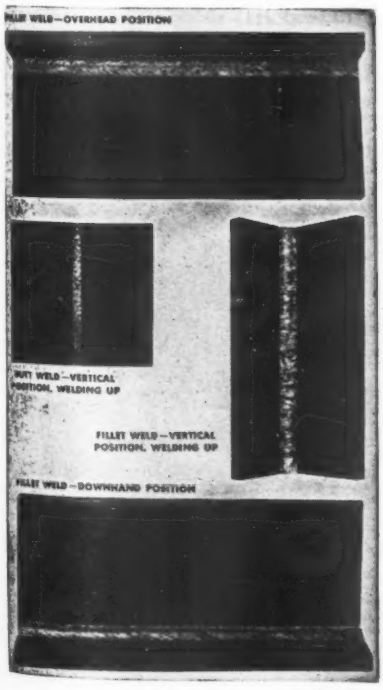


A completely new line of OIC cast-steel globe and angle valves is being announced by The Ohio Injector Company, Wadsworth, Ohio. At present available in the 150 and 300-lb. pressure classes, they are a companion line to the OIC steel gate valves already on the market.

An essential feature is the fact that they are offered with either spherical or plug type disks and seats, in a number of trims, adapting them to fluid control in either full-flow or throttling service.

(2) *Welding electrode*

A new shielded arc electrode for general purpose welding of mild steel that has a number of outstanding features is announced by The Lincoln Electric Company, Cleveland, Ohio.


FILLET WELD—OVERHEAD POSITION
BUTT WELD—VERTICAL POSITION, WELDING UP
FILLET WELD—VERTICAL POSITION, WELDING UP
FILLET WELD—DOWNHAND POSITION

The new electrode, designated as "Fleetweld 47," offers such features as extremely low spatter loss, easy slag removal (most welds are practically self-cleaning), excellent re-striking characteristics, and other improvements.

"Fleetweld 47" conforms to American Welding Society electrode specifications Class E-6012 and E-6013 and may be used with either alternating or direct current. "Fleetweld 47" is especially well suited for making high speed horizontal or flat fillet welds over 4 in. long in which the coating can be dragged on both plates, it is stated. It has also been used extensively for both vertical and overhead fillets, especially where large single pass fillets are desired.

The ease of complete slag removal on square edge butt welds makes "Fleetweld 47" exceptionally excellent for this type of joint. Complete penetration of ¼-in. plate can be obtained by welding one pass from each side.

This new electrode is available in the following sizes: 5/32 in. by 14 in.; 3/16 in. by 14 in.; ¼ in. by 18 in., and 5/16 in. by 18 in. The electrodes are packed in 50 lb. containers.

This latest addition to the popular "Fleetweld" line of Lincoln electrodes has undergone extensive field tests with excellent results. Suitable for welding a wide variety of joints in all positions, "Fleetweld 47" produces smooth, uniform beads as shown in the accompanying photo of weld specimens.

(3) *Salt bath furnace*

A new internally heated electric salt bath furnace of exceptional size especially designed and built for heat treating (in vertical position) long broaches and similar work, which are likely to distort when heat treated horizontally, has been announced by Upton Electric Furnace Division, 7450 Melville at Green, Detroit 17, Michigan.

The noteworthy feature of the furnace is its extreme depth in comparison with its surface area. The depth being 81 in. whereas the surface is only 9 in. square.

Such proportions have heretofore never been successfully combined in an internally heated electric salt bath furnace due largely to the limitations of the conventional type of electrodes, the manufacturer states. Upton electrodes enter through the sides of the furnace and at the bottom of the pot. Thus, with no space required for electrodes in the working area of the pot itself, the pot need be only of sufficiently large surface area to admit the work.

Proof of the efficiency of the new design is provided in actual operation where, while a temperature drop of 4°F. (just enough to actuate the "on" and "off" controller) can take place at the bottom of the pot, the molten salt at the top of the pot remains at practically constant temperature. Moreover, when long pieces of cold work are introduced into the bath, there is a uniform drop in temperature through the entire bath.

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All items are numbered. A business reply card requiring no postage if mailed within the United States is provided. Check or encircle the number on the card that corresponds with the product or products in which you are interested and drop it in the mail. Literature and prices will be sent promptly.

(4) *Tank heater*

Newly introduced by The Brown Fintube Company, Elyria, Ohio, manufacturers of resistance welded, integrally bonded fintubes and fintube heat transfer products, is an immersion type steam tank heater, used with any material the viscosity of which can be lowered by heating. The heaters speed up the emptying of tank cars and permit many viscous materials to be handled in cars not fitted with steam coils.

As illustrated herewith, the heater consists of a number of lengths of Brown Fintubes connected in series, and inlet and outlet steam lines. The heaters have low center of gravity. They can be handled safely by one man, or very easily by two men. Cross handles aid in positioning the heater over the discharge outlet in the car, in blocking the heater at various depths, and removing the unit after the car is empty.

They are supplied in two sizes: The No. 642 for use with tank cars and the No. 442 for use with tank trucks.

(5) *Aldrich-Groff pump*

A 3-in. stroke, 20-hp. unit has recently been added to the line of Aldrich-Groff controllable capacity pumps. Orginally introduced 4 years ago, the line now consists of 20-hp., 40-hp., 60-hp., and 100-hp. units, which cover a wide range of capacities at various pressures up to 15,000 lb. per sq. in.

Primarily used for boiler feeding, desuperheater feeding, pipe line, process charging, and proportioning, these pumps are being installed in increasing numbers wherever accurate, automatic control of delivery is important, according to the manufacturer. Operated at constant speed, from no-load to full rated capacity, power consumption of Aldrich-Groff pumps is virtually proportional to discharge. Substantial power savings are thus realized, it is asserted.

(6) *Recording instruments*

A new group of recording instruments designated Televac has just been announced by Precision Scientific Company, 1750 North Springfield Avenue, Chicago 47, Illinois.

The type "MR" instrument with a range of 0-500 microns utilizes the new Televac No. 500 thermal gage with specially treated elements. Features of the latter include: (1) Coated filaments to prevent "off calibration" periods due to water, oil vapor or other contaminating vapors, (2) increased sensitivity gained through use of two filaments in both standard and variable tubes of the vacuum gage, (3) all gages are interchangeable without recalibration, and (4) the user is assured of duplicate readings in terms of absolute pressure in microns. The gage is supplied with a special Leeds and Northrup Micromax strip chart recorder calibrated directly in microns.

The type "S" Recorder for ultra vacuum contains two ranges: 0-500 microns for pressures above 1 micron, and utilizing the No. 500 thermal gage in this range and an industrial type ionization gage for the range 0 to 0.4 microns. Accurate readings may be obtained down to 10^{-4} mm Hg. (0.001 micron). The type "S" instrument also features a safety circuit that makes it impossible to turn on the ionization gage until a vacuum of 1 micron has been reached. Average life of ionization gage is 3000 hr.

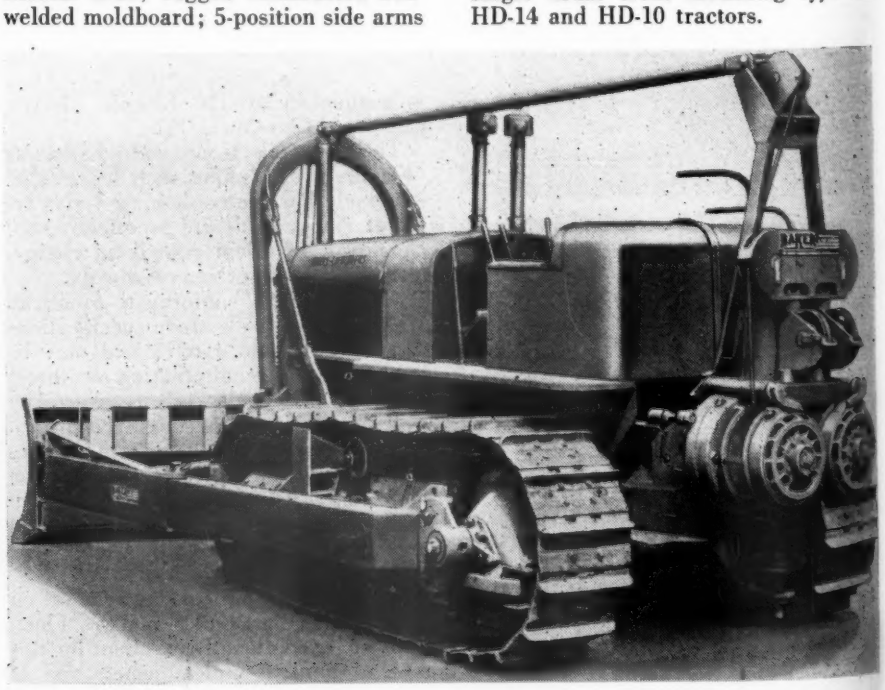
(7) *Cable controlled bulldozers*

More than 20 years ago, Baker engineers designed and built the first successful hydraulic bulldozer for what was then the Monarch Crawler Tractor, later taken over by Allis-Chalmers. Improvements were made from time to time in keeping with refinements in the design and construction of A-C tractors. Ultimately, the present and well known Baker hydraulic bulldozer and gradebuilder was evolved, readily recognizable by its overhead tie bar and distinguished for its direct lift and full down pressure on the blade.

Now, after nearly a quarter-century of building earth moving equipment and after experimenting and study of various designs, Baker is introducing a line of cable controlled bulldozers and gradebuilders and power control units made exclusively for Allis-Chalmers HD-14, HD-10, and HD-10W tractors.

Features include: Sturdy, reinforced tubular arch; rugged constructed box-welded moldboard; 5-position side arms that permit tilting of blade up to 10 in. on the bulldozer and 12 in. on the gradebuilder from a perpendicular position; 42 in. blade lift above ground on bulldozer, 50 in. on gradebuilder; blade drop below ground level limited only by length of cable.

The power control units feature differential or self-energizing brakes whereby the dead end load assists the spring in setting the brake and is arranged so that the differential factor increases as band lining wears. Less pressure is required on hand lever in releasing brake; "air-conditioned" cone type clutches and band brakes are employed; brakes have 3-in. bands; all adjustments made from rear—easy to get at; drum barrel has curved contour at anchor end of drum that assists rope to wind closely at start of winding. Power control units are made in heavy duty double drum and single drum types for rear mounting on Allis-Chalmers HD-14 and HD-10 tractors, double and single drum medium duty units for HD-7 tractors, and a single drum front mounting type for HD-14 and HD-10 tractors.



BUY WAR BONDS

Announcing

NEW ★ COMPACT ★ HEAVY DUTY CLIMAX BLUE STREAK ENGINE

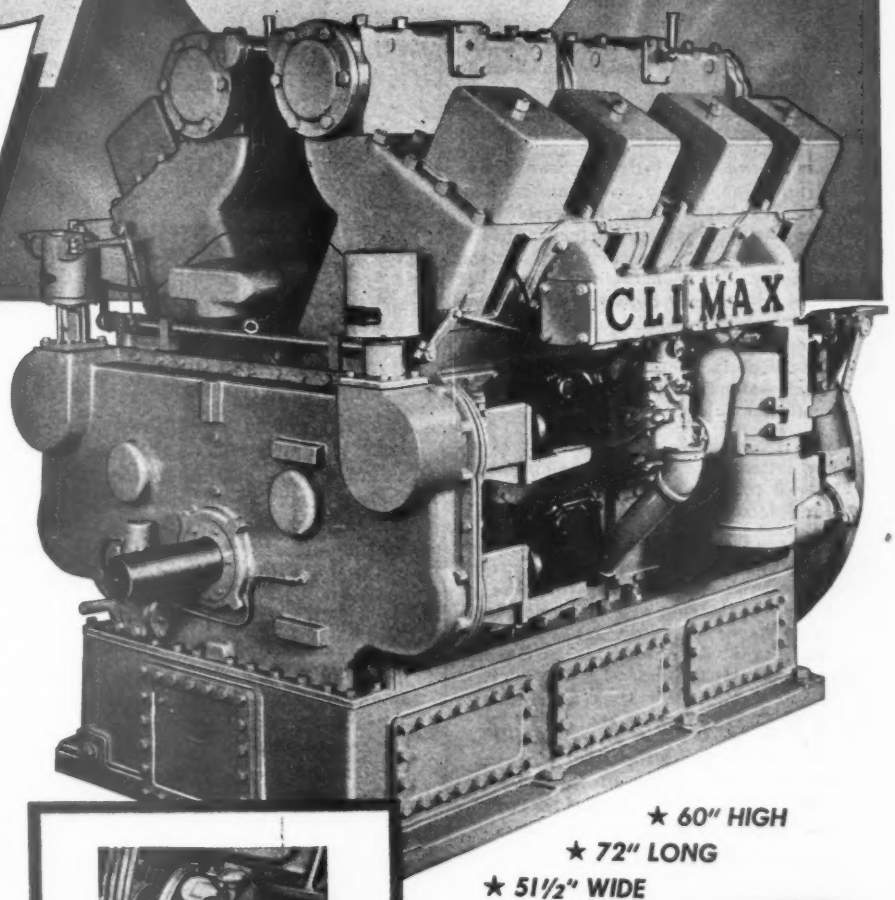
330 [illegible] at 1200 r.p.m.

Climax Built-in Extras AT NO EXTRA COST!

1 *Hi-Power Blue Streak Combustion (exclusive).*

2 *Hi-Efficiency Dual Carburetion.*

3 PLUS *Staying Power—the ability to keep on doing the job.*



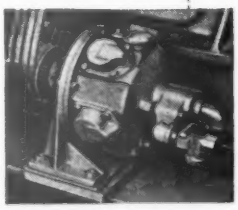
★ 60" HIGH
★ 72" LONG
★ 51½" WIDE

HERE IS BRUTE POWER—in small space—to operate heavy duty mobile or stationary equipment used in oil fields, construction, marine and industrial operations—to power deep-drilling rigs, locomotives, cranes, shovels, boats, generators, air compressors, water and sewage pumps, blowers, etc.

This Climax valve-in-head Blue Streak V8 (8 cylinder, 4 cycle, 7" bore, 60°) Engine is a sturdy, instant-starting, fast-accelerating, smooth-running, flexible prime mover that operates on gasoline, butane, by-product or natural gas. It runs at slow, minimum-wear speeds, at low, safe temperatures in all climates on very little water.

This new V8 promises to sustain Climax Engine records of 7, 9, 10 years' trouble-free service—as much as 60,000 hours of continuous operation with no shutdown for repairs.

For complete operation and specification bulletin, write Climax Engineering Company, Clinton, Iowa.



AIR START now available, belt connected or built-in, according to engine size, on all Climax Blue Streak Engines. Choice of air start or gasoline starting optional.

climax
BLUE STREAK ENGINE
Builder of Climax DIESELS and GENERATING SETS

CLIMAX ENGINEERING COMPANY

CLIMAX ENGINEERING COMPANY
General Offices: CLINTON, IOWA
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"Good Makings"
Make a Good Water System

You can always put your utmost confidence in a Layne Well Water System. Everything from the method used in drilling and finishing the well to the design, manufacture and installation of the pump can be trusted for highest efficiency, most durable quality and the longest life of service.

Shown above is a system recently completed for a major food manufacturer. Running true to Layne form, this system out performs its guarantee, producing nearly twice as much water as other wells in the same locality. This manufacturer knew what to expect. He already owns four other Layne Well Water Systems, all of which have always given outstanding service. He knows how little it costs to operate Layne Systems, how much water these systems produce and how small the upkeep cost.

Layne is already in postwar work. Many postwar installations are now being made. Others will soon be started. All will be of the world famous Layne quality.

If you need more water, either from entirely new wells and pumps, or from efficiently modernized old ones, write, wire or phone for the planning and estimating services of a Layne engineer. No obligation. Address Layne & Bowler, Inc., General Offices, Memphis 8, Tenn.

LAYNE PUMPS — *fulfill every need for producing large quantities of water at low cost from wells, streams, mines or reservoirs. Send for literature.*

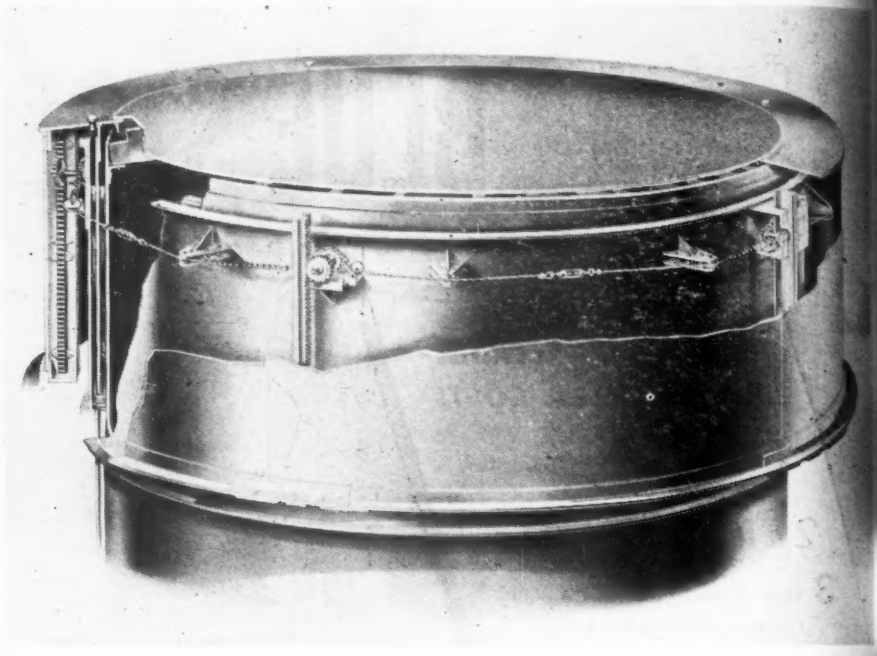
AFFILIATED COMPANIES: Layne-Arkansas Co., Stuttgart, Ark. ★ Layne-Atlantic Co., Norfolk, Va. ★ Layne-Central Co., Memphis, Tenn. ★ Layne-Northern Co., Mishawaka, Ind. ★ Layne-Louisiana Co., Lake Charles, La. ★ Louisiana Well Co., Monroe, La. ★ Layne-New York Co., New York City ★ Layne-Northwest Co., Milwaukee, Wis. ★ Layne-Ohio Co., Columbus, Ohio ★ Layne-Texas Co., Houston, Texas ★ Layne-Western Co., Kansas City, Mo. ★ Layne-Western Co. of Minnesota, Minneapolis, Minn. ★ International Water Supply Ltd., London, Ontario, Canada ★ Layne-Hispano Americana, S. A., Mexico, D. F.

LAYNE

WELL WATER SYSTEMS
VERTICAL TURBINE PUMPS

(8) *Vapor-lift tank roof*

Hammond "Vapor-Lift" roof tanks, manufactured by the Hammond Iron Works of Warren, Pennsylvania, are so designed and built that they provide a variable vapor space of ample capacity to permit the expansion or contraction of vapors thus eliminating breathing. This variable vapor space is positively sealed so that vapors cannot escape, breathing losses will be eliminated, filling losses reduced, and the quality of the stored product maintained, it is stated by the manufacturer.



Under normal conditions the "Vapor-Lift" roof will rest on the roof supports as in the conventional cone roof tank. As the volume of vapor in the tank tends to increase the roof will rise to make room for the increased vapor, lowering itself when the volume of vapor tends to decrease.

A single "Vapor-Lift" roof tank (available in sizes up to 100,000 bbl.) can be provided with excess vapor capacity to accommodate the breathing of additional cone roof tanks.

The outstanding feature of the "Vapor-Lift" roof tank is the simple and rugged stabilizing means provided to insure the roof being kept level at all times regardless of lateral wind or unbalanced snow loads. These stabilizers consist of gear and rack units, mounted as illustrated and synchronized by a continuous chain and cable with take-ups. Roller guides, mounted on non-corrosive bearings, insure true vertical alignment of the roof during its travel. All equipment is outside the tank where parts are quickly accessible for inspection.

The vapor space of a tank, equipped with a "Vapor-Lift" roof, is sealed by the oil seal and the dip ring, as shown. The dip ring, an integral part of the roof, rides in the oil chamber thus reducing and enlarging the vapor space in the tank. The liquid seal chamber is filled with an oil selected to meet the lowest operating temperature. It seals the dip ring to prevent the escape of vapors.

The weather skirt is of reinforced, rigid construction to form a canopy that protects the liquid seal and the stabilizers against the elements.

The outer rim of the roof incorporates a heavy circular girder that maintains the shape of the roof constant under all working conditions and insures trouble-free operation unaffected by wind, snow, ice, or rain. No section of the roof is forced to bend or distort so there can be no possibility of deterioration of metal due to fatigue resulting from reversal of stresses.

A drip ring, attached to the under side of the roof just inside the tank shell, serves as a barrier to prevent any vapors that condense on the under side of the roof plates from getting into the liquid seal, thus conserving these vapors and at the same time maintaining the original gravity of the liquid seal.

(9) *Steam trap*

Designed for pressures up to 600 lb., or where all-steel fittings are desired, a new cast-steel inverted bucket steam trap with side inlet, side outlet pipe connections, has been announced by the Armstrong Machine Works, Three Rivers, Michigan. It is available with ½ in., ¾ in., or 1 in. screwed or flanged connections. Flanges are welded into the trap body. Height is 11¼ in.; dimensions between flanges range from 11⅜ to 12⅛ in., depending upon pipe sizes.

The inverted bucket and valve lever are made of 18-8 stainless steel; the valve and seat are chrome steel hardened, ground, and lapped. One of the features of the trap is that the cap and interior mechanism can be removed for inspection or repair without breaking either the outlet or inlet connections. The cap and working parts are removed as a unit by unbolting the cap, leaving the body intact on the line.

Air Cooled Brakes

All Allis-Chalmers Well Servicing Units are equipped with Cooper, patented, circulating air cooled brakes, which keep the temperature of the brakes BELOW the maximum operating temperature prescribed for the lining, thus assuring a high co-efficient of friction and BRAKES THAT HOLD.

for WELL SERVICING *and* SPUDDING!

The Allis-Chalmers Model L Units are the most flexible and efficient pieces of equipment for servicing rods and tubing, bailing, swabbing, cleaning-out, well deepening and drilling with either rotary or cable tools.

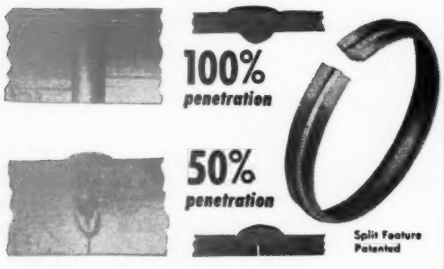
The Model L SKID WINCH has a maximum line pull of 66,730 pounds. Available with either 52″ brakes, line capacity 15,030′ of ¾″; or 42″ brakes, line capacity 9,130′ of ¾″. Winch drum has EIGHT line speeds to 1,059 feet per minute at 1,200 engine r.p.m. This unit is also available in the A-C Model L Winch Tractor Unit. These units will service the deepest wells with ease and speed.

A Cooper Service Engineer will gladly submit detailed specifications.

..Use THIN WALL PIPE and WEDGE Split CHILL RINGS to..

SAVE TIME and MONEY

Many engineers are using thinner pipe and welding the joints with WEDGE Chill Rings with the patented SPLIT Feature. WEDGE Chill Rings REINFORCE the joints and, therefore, thin wall pipe can be used at a considerable saving. You can weld FASTER and BETTER and also use less skilled help and get first-class work and your experienced help can do much more. WEDGE Chill Rings reduce welding time and fewer welding electrodes are used. For any pipe welding job in refinery or for pipe lines it will pay to use WEDGE Chill Rings. Write today for details.



Write for Information

WEDGE PROTECTORS, INC.

9522 Richmond Ave., Cleveland 5, Ohio

WEDGE Split CHILL RINGS SAVE MONEY

(10) *Rotary Pumping Unit*

To meet the requirements of manufacturing plants, petroleum bulk station operators, and other applications where temporary pumping facilities are needed, and for use by the armed forces, Blackmer Pump Company engineers have developed a self-contained rotary pumping unit powered by a Wisconsin gasoline engine.

The unit consists of a 90 gal. per min. bronze fitted standard Blackmer pump with built-in chatter proof relief valve, oil immersed drive, and 2-hp. gasoline engine, all mounted on a fabricated steel base that is fitted with telescopic handles for convenience in moving. The complete unit weighs 330 lb. and is easily carried by two men.

According to J. B. Trotman, general sales manager of the company, the new units are now in production and deliveries are currently being made.

(11) *Housing problem*

With pressure constantly being placed upon the oil industry to produce more and more 100-octane gasoline, an official investigation has revealed that inadequate housing facilities for field workers and others is a serious bottleneck that must be broken.

In some localities where new fields are being developed, workers must travel a round trip of better than 100 miles a day. Not only is this a wearying ordeal, but results in a dangerously high quit-rate. Furthermore, it discourages the attraction of new workers leaving non-essential for war-essential work. Obviously, this leaves the matter of increasing high-octane gasoline production still in a bad way.

The same official investigation referred to above, did discover a bright spot on the housing horizon. It brought to light the quick availability of comfortable and practicable "Homettes"—cheery, convenient, attractive little homes, manufactured by Texas Pre-Fabricated Housing Company.

"Homettes" provide accommodations as astonishingly complete as are found in many conventional homes. Yet they are space-engineered to provide the step-saving economy of a studio apartment.

Further, if the need arises, Homettes can be demounted (in only a few hours and with full salvageability) and moved on to another locality and another job.

Of prime importance to the oil industry today, however, is the fact that "Homettes" can be shipped within two or three weeks after orders and proper priorities are received by the manufacturer. Hence, "Homettes" provide housing when it is needed most seriously.

Needless to say, many major oil companies as well as drillers, producers, and others are now more optimistic than they have been in months since discovering that "Homettes" provide a quick practical answer to housing oil field workers — satisfactorily, comfortably, and economically.

"Homettes" are made by the Texas Pre-Fabricated Housing Company, Dallas, Texas.

BUY WAR BONDS

(12) *Bath pyrometer*

More uniform quality has been assured important tonnages of wartime open hearth steel by the use of a new "bath" temperature gage developed by research experts of United States Steel Corporation. True to its scientific name, "pyrometer," or fire measure, this 6-ft. pipe-like instrument, now in broad corporation use, reads temperatures at their height by sticking its black metallic nose beneath the bubbling slag surface of the bath and measuring directly the incandescence of white hot molten steel.

In heating a furnace charge of steel scrap, pig iron, and limestone up as high as 3000°F. to purify the raw materials and make a steel whose chemical composition will be exact, it is important

that the melter check his temperatures frequently, especially at the top. One phase of the melting process is oxidation; some of the carbon must be literally "burned out" of the melt at high temperatures, and the proportion of certain other elements that must be present must be controlled.

For many years the steel industry has felt the need for an accurate method of measuring the temperature of liquid steel in the open hearth furnace. Specifications for such a temperature gage are severe. The instrument must be portable so that it may be moved quickly out of the way to clear the floor for furnace charging. It must be rugged enough to stand steel mill conditions, dust and vibration. It must make an automatic record, reducing to the minimum the chance of human error. Preferably, it should not require highly experienced personnel to operate it successfully. Finally, it must do a better job than is now being done by the melter's trained eye. These requirements are fulfilled by the new open hearth bath pyrometer, officials of the United States Steel Corporation state.

Now, As In The Days of Damascus

THERE'S SAFETY IN GOOD STEEL!

D+B HEATREAT SUCKER RODS

THE ancients developed properly heat-treated steel for strength and safety.

Today's drilling operators depend upon the fine materials and exacting precision workmanship embodied in D+B Heatreat Sucker Rods for safe, efficient performance.

There's no substitution for fine materials or precision workmanship in D+B rods. They are fabricated from carefully made medium carbon steel, with rigid standards of control all the way from steel mill to your well.

On your next string of rods try D+B . . . for efficient and continuous service over the longest period of time.

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CONTINENTAL

SERVING THE OIL AND GAS INDUSTRIES

NOW I ASK YOU-

- Do you really believe I am the proper person to do this sort of work? I do not!
- In fact, I am just about as efficient at this as the average sand pump or clean-out bailer is at cleaning out an oil well.
- Confidentially, if you want a real clean-out tool go to your nearest supply store and order the tops among all clean-out tools . . .

TYPE G

"THE MIDCO BAILER"

- Every individual feature of the MIDCO contributes in some degree to the almost unbelievable results obtained.
- Large volume of sales in both Domestic and Foreign fields permits maintenance of price competitive with any clean-out tool.
- Distributors located in practically all fields make replacement parts readily available.
- G-TYPE has solid steel plunger rod—exceptionally sturdy construction throughout.

Standard cable tool pin permits Jars and Sinker to be run above pump, eliminating fishing jobs.

- F-5 TYPE has patented plunger construction to assure highest possible efficiency in this type of pump.

PATENT No. 2061486
2090055 — 2090209
2176231 — 2187042
Other Patents Pending
TYPE-G TYPE F-5

TYPE F-5

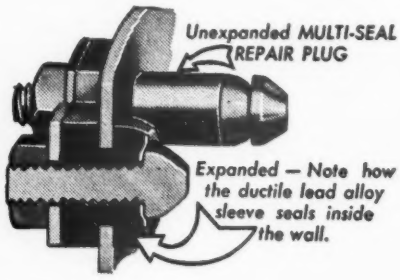
For additional information see COMPOSIT CATALOG, Page 1903
Call, wire or write

MIDCO BAILER CO.
1006 - 1012 S. E. 29th STREET
TELEPHONE 7-8586 BOX 1542
OKLAHOMA CITY · OKLAHOMA

(13) *Tank repair*

Rolyan Multi-Seal Repair Plugs, which are being introduced into the oil fields, enable one man to stop leaks permanently in tanks, boilers, and other metal containers. Installation is made from the outside without emptying the container.

As illustrated, the Multi-Seal repair plug is merely inserted into the hole and



the nut drawn up tight to form a leak-proof seal of everlasting lead alloy. The Multi-Seal repair plug seals inside the wall, in the hole, and outside the wall. There is no spark hazard. The lead alloy is non-corrosive and makes a permanent seal. Sizes are from ¼ in. to 1½ in.

(14) *Hazegage for diesels*

Diesel engine exhaust has long been recognized as a primary index of combustion efficiency. However, until the Hazegage was developed by The Ess Instrument Company of Ft. Lee, New Jersey, the evaluation of exhaust haze involved considerable equipment and a time lag that prevented the instantaneous and constant monitoring of fuel-air ratio in order to maintain the quality of haze indicative of optimum engine efficiency, it is stated by the Hazegage manufacturer. Another factor of major import and not generally known or recognized by operators and owners of diesels is that smoky exhaust indicates danger from sludge forming in the lubricating oil.

Diesels equipped with Hazegages can be operated at optimum efficiency and without the danger of sludge forming in the lubricating oil.

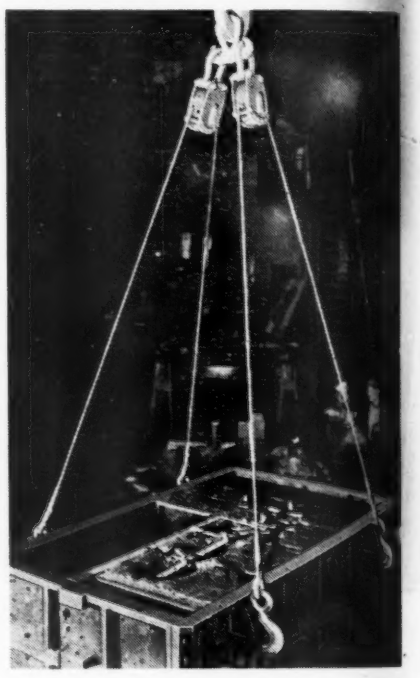
A Hazegage consists of three parts: A light unit, a photoelectric unit, and an indicator that has a scale (zero to 100, left and right) and two different colored lamps (red and green). In operation the light unit, equipped with a standard electric bulb, shoots a path of light through the exhaust haze; the photoelectric unit measures the density of the haze in the path of light and shows it on the scale of the indicator. Whenever combustion varies so that the haze is either too thick or too thin, the lamps will light; green for too thin a haze and red for too thick a haze. The pointer on the scale, being set to zero to show optimum haze, will move to the left for too thin or to the right for too thick a haze. As the fuel-air ratio is corrected the lamps will go out and the pointer will go back to zero on the scale—indicating optimum engine efficiency.

If desired, sound alarms can be supplied with each Hazegage or if records are required, recorder equipped Hazegages are available to keep a 24-hr. record of the performance of one or a battery of diesels.

(15) *Level-Lift" slings*

The complete line of Macwhyte Caldwell "Level-Lift" slings, all patented, are now made in ¾-ton, 1½-ton, 3-ton, and 6-ton. capacities. Formerly made only in 3-ton and 6-ton capacities, increasing demands for smaller units lead to the addition of two new sizes, ¾-ton and 1½-ton.

Operation is simple. After the lightweight block containing wire rope is put on the crane hook, the crane operator spots the crane hook over the approximate center of gravity of the load



Slings handling a foundry flask.

and the floormen attach the sling to the load.

The crane operator then applies the power to lift the load, and as the crane hook is lifted, the rope automatically adjusts itself through the 'Level-Lift" block. In so doing, one sling leg of rope becomes longer than the other, and as the weight of the load pulls on the wire rope, the sheave in the block pulls down against a brake that prevents slippage. The load is then lifted level.

Should the crane operator not get the block and crane hook close enough to the center of gravity of the load, it is only necessary for the operator to lower the load enough to relieve tension on the sling, which releases the brake, and then move the crane hook over a little to the true center of gravity. On applying the power, the ropes readjust themselves and the load rises level.

BUY WAR BONDS

Byron Jackson has pioneered in careful engineering and metallurgical control with the result that all BJ Oil Tools for both production and drilling are designed for safety and efficiency in operation without excessive bulk.

Assurance to operators in the field has been established through API ratings on all BJ production tools. Under the API code the maximum rating must be 25 percent of the actual breaking load of any part of the completely assembled unit which would cause the load to be released.

Use BJ Production Tools and you know you have a four to one safety factor.

We give 'em the works to prove our point and assure your safety. At the left is shown a BJ 75 Ton Single Body Tubing Hook during tension test in the University of California's Southwark-Emery 3,000,000 lb. precision universal testing machine.

BYRON JACKSON CO.

Houston • LOS ANGELES • New York

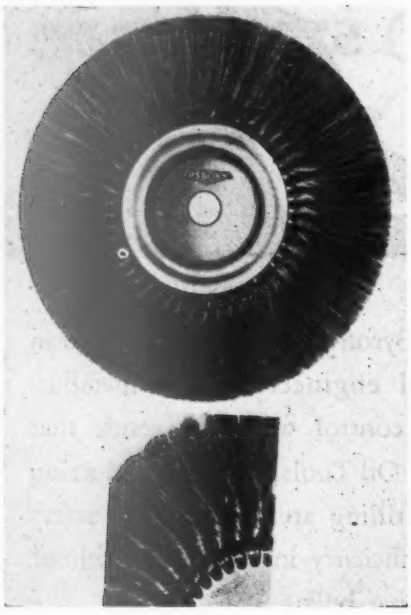
BJ STANDS FOR ENGINEERED OIL TOOLS

(16) *Power brushes*

The oil and gas industry, one of the most versatile users of power brushing as a means of completing difficult jobs faster and more efficiently, now adds another use—that of power brushing for the cleaning of steel plates in oil field storage tanks.

Removal of rust, grease, mill scale, welding slag, old paint, and corrosives from these tanks by power brushes is described in a report received from a large Houston, Texas, company by The Osborn Manufacturing Company of Cleveland, Ohio, producer of wire brushes.

Single plate cleaning jobs, when they are disassembled from the tank, can be



performed on a flat surface by applying the disk-center cup-shaped brush that is mounted to an electric or air grinding tool. Grinders operating at about 4500 r.p.m. have shown best results.

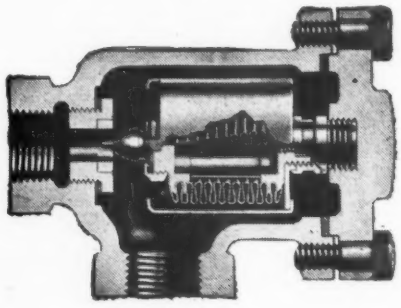
The type of power brush being used on most storage tank cleaning operations is especially designed for high speed operation with each knot or tuft in the section securely mounted in a one-piece center. There are no welds or joints to fail under severe operation. The brushes measure 6 in. in diam. and are ⅜ in. in thickness, with 0.025 wire.

(17) *Steam traps*

Thermostatic steam traps have many well recognized features. As they work on the differential pressure between the inside and the outside of the bellows element, change in operating pressure does not necessitate change of valve seat. A given trap will work with equal efficiency at any pressure up to its maximum rating.

Due to the great lifting power of the thermostatic element, these traps have much larger valve orifices than can be provided on float or bucket types. This means several times the air venting capacity and, therefore, very rapid heating up from a cold start. When installed outdoors, they need no protection against freezing.

In the past, the use of thermostatic traps at pressures greater than, say 50



lb. per sq. in., has been restricted to small equipment because flexible bellows of sufficient strength could be made only in small sizes, according to the manufacturer.

Sarco Company, Inc., 475 Fifth Avenue, New York 17, New York, has announced the manufacture of bellows from heavy wall bronze tubing, drawn and helically corrugated in their own plant by methods developed by them. These have made possible the introduction of an entirely new line of thermostatic steam traps, for pressures up to 225 lb. per sq. in., using single, large diameter bellows, for inlet sizes ½ in. to 2 in., inclusive, and with capacities double those of the company's well known No. 9 series.

The new traps are available in two pressure ranges, No. 9-100 for pressures 0 to 100 lb. per sq. in. and No. 9-225 for pressures 0 to 225 lb. per sq. in.

(18) *Improved latch*

The Thomas Laughlin Company, Portland, Maine, announces a newly designed latch for their safety hooks, used for general hoisting and materials handling, plane and cargo lashing, suspending tools, etc. This improved latch gives 80 per cent of the full throat opening, and its proper operation decreases the possibility of overloading and overcrowding, it is stated.

The wider throat opening results from the ingenious way the latch assembly, when open, straddles the neck of the hook. The load to be hoisted is easily slipped into the hook but cannot be removed until the operator's fingers release the latch, thus preventing risk of dropping loads and endangering bystanders. If the hook is overcrowded, the latch will not snap into place. If the hook spreads because of excess loading, the latch pops up as a warning signal.

Made of pressed steel in the smaller sizes and cast bronze in the larger, this improved latch is riveted at the neck of the hook to a cam that is an integral part of the hook forging. The latch is actuated by a stainless steel wire spring (corrosion-resistant and ideal for outdoor use), which coils around the hub of the cam on each side and extends down the inside of the latch.

Safety hooks with these new latches are modifications of standard eye, straight shank and swivel types with safe working load capacities from ½ to 15 tons.

(19) *Oil well sealing*

Wilmington Chemical Corporation, 10 East 40th Street, New York, New York, in collaboration with the Synvar Corporation, Wilmington, Delaware, announces the availability of a resinous compound, developed especially for sealing oil wells. The new product, known as Synvar Oil Well Sealing Compound, provides a water and oil-resistant seal, and forms an integral and uniform structure with rock formation and pipe. A minimum of shrinkage is assured, and the new compound can be used at any practical temperature, it is stated.

The product is supplied in separate components, which are combined just before use, with the proportions of the different components adjusted to suit existing well conditions.

(20) *Air control*

The announcement of a new simple, rugged, durable, dependable air control for shallow well pumps is made by Manning, Maxwell and Moore, Inc., Bridgeport, Connecticut.

In placing this new Ashcroft air control on the market, the manufacturer announces many features exclusively Ashcroft. They include rubber diaphragm as the one single moving part that combines valve head, gland seal, and float hinge. The valve has stainless steel orifice and is completely sealed. It has no water cavities. The body is either cast brass or cast iron. The unit is compact, of light weight, and measures 1¾ in. between wrench flats. The control is for applications up to 80 lb. per sq. in tank pressure.

WITH A MISSION PISTON YOU GET LONGER UNINTERRUPTED SERVICE

ADVANCED DESIGN AND TOUGHER RUBBER COMPOUND GIVE MISSION PISTON RUBBERS EXTRA LONG LIFE

Extra long piston rubber life brings longer runs between replacements, and less slush pump shut-down time.

Then, after a long, uninterrupted run, you renew the piston by simply installing new rubbers without even removing the piston from the rod. Furthermore, you save the cost of the piston body (about half the cost of the entire piston).

Guaranteed: Proved long life and low replacement cost enables us to guarantee Mission Pistons to be the most economical on the market to operate.

Thousands of operators all over the world have found that Mission Pistons speed up drilling by improving slush pump performance.

WITH MISSION, YOU "CHANGE THE RUBBERS AND SAVE THE PISTON"

Use all
MISSION PUMP PARTS
They work together for best all round performance

4A-14

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HUMBLE ROAD HOUSTON, TEXAS

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TO SHUT IN
Gas Wells with
EXTREME
PRESSURES
USE
ROBINSON
HIGH
PRESSURE
THREE-IN-ONE
PACKERS

One of the outstanding qualities of this famous Robinson product is the unusually large expansion obtained by using double or triple lengths of rubber, the lower one telescoping the one above.

In addition, the perforations above the rubber permit this packer to be run in against enormous gas pressures, tending to equalize the pressure above and below the rubber.

Other trouble-saving features of the Robinson High Pressure Three-In-One Packer:

- May be set any distance from bottom of the well.
- Mud or fluid may be used on top of the packer to assist in holding high gas pressures.
- Weight of tubing or casing sets packer when bottom of hole is reached.

ROBINSON
PACKER CO.
P. O. Box 1408
TULSA, OKLAHOMA
Factory: Coffeyville, Kansas

(21) *Pressuregraph*

Electro Products Laboratories, Inc., 549 West Randolph Street, Chicago 6, Illinois, announces a new product, known as the Pressuregraph, designed to meet the needs of many manufacturers and engineering laboratories for a linear pressure-time-curve indicator.

It is said by the manufacturer that this new electronic device will indicate, in linear response on the screen of a cathode ray oscillograph, the pressure-time curve of any internal-combustion engine, pump, airline, or any other enclosed pressure system where pressure measurements are desired. The Pressuregraph measures either static or dynamic pressures. It is stated to have been successfully applied to 2-cycle engines to show pressure-time-curve of main cylinder or crankcase and also to have been used on C. F. R. aviation fuel test engines for measurement of pressure-time-curve.

In operation, the pickup section of the Pressuregraph is inserted in the cylinder, chamber or airline, etc., to be pressure measured. The pickup response is transmitted, after amplification, to the screen of a cathode ray oscillograph.

Additional advantages claimed for the Pressuregraph are simplified operation, only one control being required, with one initial adjustment to compensate for temperature effects.

(22) *Fire hose*

A tremendous new aid in combatting refinery and oil well fires—a new type of fire hose employing synthetic rubber—is announced by The Goodyear Tire and Rubber Company, Akron, Ohio.

W. C. Winings, manager of Goodyear's mechanical goods division, and R. W. Sanborn, manager of the hose department, disclosed that the hose is especially suited also for fire protection in chemical, acid, and fertilizer plants as well as for street cleaning and sewer flushing.

Designated by Goodyear as Style "M" fire hose, the use of synthetic rubber on this product provides complete resistance to oil, acid fumes, sunlight, mildew and rot, according to Winings and Sanborn.

This is important in the case of refineries and oil wells, it is said, because fire hose frequently comes in contact with oil and gasoline during use. In addition, it is subjected to fumes while not in use. Thus conventional fire hose, after being subjected to such conditions, is more apt to fail in emergencies.

The synthetic rubber interior of the hose—a different type of synthetic rubber than the exterior sheath—is likewise resistant to deteriorating action from special fire-fighting compounds.

Winings and Sanborn announced that the wrapped plies of Goodyear's new Style "M" fire hose, consisting of finest quality cotton duck, are between the interior synthetic rubber tube and exterior synthetic rubber cover, differing from conventional fire hose wherein a woven cotton jacket forms the exterior.

In addition, the cotton plies of Style "M" fire hose are treated especially with a Goodyear compound to inhibit mildew and rot. Other features include special Goodyear methods of treating the duck and rubber for age resistance.

Goodyear's new Style "M" fire hose is being produced in 1½-in., 2-in., 2½-in., and 3-in. diameters.

(23) *Plastic coatings*

Positive control of corrosion by air drying plastic coatings is now possible, it is asserted by Oil Trading Company, 30 Rockefeller Plaza, New York 20, New York. Exterior coating films have been developed that are unaffected by exposure to petroleum products or vapors, dilute mineral acids or alkalis, such as hydrogen sulphide, sea water, salt in air or solution, oxidizing agents as nitric or chromic acids. They are non-conductors and, therefore, prevent electrolytic corrosion, have a high degree of ductility, excellent abrasion resistance, are fireproof, and will not support combustion. Corrosion is effectively prevented for long periods. The coating is applied in the same manner as paints and is in the same price range.

Interior coatings have the same characteristics and remain unaffected by crude oils, gasoline, distillates, and other fractions of lower than 30 per cent aromatic content. Different coatings are specifically recommended for various corrosion problems. Suggested applications are for barge, storage tank, pipe lines, and equipment exteriors, storage tank, tank car, and drum linings.

(24) *Blasting caps*

All electric blasting caps now being produced by E. I. du Pont de Nemours and Company, Wilmington, Delaware, have two improvements — nylon-insulated wires and rubber plug closures.

These developments resulting from Du Pont research on explosives have been called the "greatest advances in electric blasting caps in half a century."

Both the nylon and the rubber for the new caps are allocated by the War Production Board to speed the war effort.

The wire covering of tough, abrasion-resistant nylon is the equal of enamel insulation in preventing current leakage. It is not affected by extreme or rapid changes in temperature and is in brilliant colors, minimizing the possibility of error in connections.

In addition to reducing the possibility of misfires, the new wires are clean to handle and resist kinking.

The rubber plug closures, double crimped in the shells, replace the combination of bridge plug, asphaltic waterproofing and sulphur seal, thus increasing resistance to water penetration.

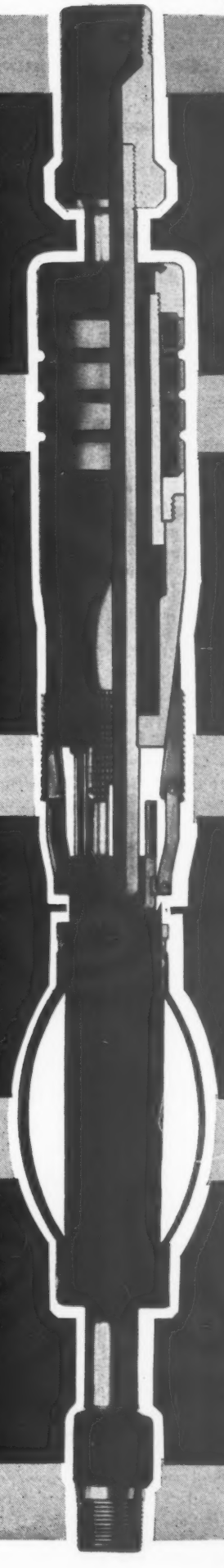
BUY WAR BONDS

You Can

PROFIT BY KNOWING

these points about

LANE-WELLS PACKERS



CIRCULATION AREA—permits fast round trips in heavy mud. The internal by-pass feature holds swabbing action to a minimum.

MULTI-SET PACKER RINGS—of sturdy resilient construction, backed up by a packing ring support sleeve, prevents collapse of mandrel and allows the packer to be set and reset many times.

CROSS-CUT DOVE-TAILED SLIPS—provide positive casing wall engagement when the packer is set. Eliminates danger of hanging up in whipstock windows or casing collar recesses.

CAGE ASSEMBLY—provides positive action for setting or releasing the packer.

Lane-Wells builds Packers to meet all operating requirements—average, medium or extreme. The Olympic Type BO-C Circulation Packer is designed for all around testing and production work, especially for fast round trips in deep wells having heavy mud or high fluid columns. The internal by-pass feature permits running this Packer in and out of the hole in a minimum of time and swabbing action. For deep wells where tubing stretch must be compensated the Packer can be furnished with a long mandrel (BO-C-30) which permits the tubing to be raised as much as two feet with safety without disturbing the pack-off.

Full details of Lane-Wells Packers, their specifications and applications are available through any Lane-Wells Branch.

Write for Bulletins.

Tomorrow's Tools-Today!

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24-HOUR SERVICE • 30 BRANCHES

TRADE LITERATURE

Publications listed are sent free upon request.

(25) *Protective coatings*

Protective coatings for metal, brick, cement, and wood surfaces are described and typical applications given in a booklet published by Reilly Tar and Chemical Corporation, Indianapolis, Indiana. Described also is Creocote paint for creosoted wood block floors, poles, guard rails, and posts.

(26) *Crosby clip*

The Crosby clip instruction booklet CCB-11B, issued by American Hoist and Derrick Company, St. Paul, Minnesota, contains full details concerning the Crosby clip and also contains a table giving the number of clips to use for all sizes of wire rope up to 3 in. Instructions are illustrated with a diagram and pictures show how to make a wire rope fastening properly.

(27) *Enthalpy-entropy charts*

Every individual who has problems in connection with the handling of gas is at some time or other interested in information that can be obtained from the mollier diagram, such as total heat, entropy, and other similar data showing the effect of changes in pressure and temperature on the work required or change of state of the gas. A series of enthalpy-entropy charts prepared by Dr. G. G. Brown has been published by Clark Bros. Co., Inc., Olean, New York, that should prove useful. The same booklet also contains a reprint of an article by Dr. Donald L. Katz, on the prediction of conditions for hydrate formation in natural gases.

(28) *General Electric bulletins*

General Electric Company has issued two bulletins. GES-3303 announces a complete set of training material on industrial electronics. GEA-4254 describes push-button units, selector switches, and indicating lights for built-in machine tool applications.

(29) *"Oilwell" bulletins*

Oil Well Supply Company, Dallas, Texas, has recently issued two bulletins. G2-245 gives specifications, an outline drawing, photographs, and description of the D-33 double reduction gear. Bulletin U13-145 illustrates and describes the TC-23 HB and TC-33 HB twin-crank pumping units.

(30) *Telephone systems*

Kellogg Switchboard and Supply Company, Chicago, Illinois, has prepared a new bulletin that gives detailed description and illustration of its modern PAX system, its operation and variety of organization uses.

(31) *Planning guide*

Planning information on 10,000 to 60,000-kw. condensing turbines, surface condensers, and auxiliaries, for building a new plant or adding generator capacity to an existing one, is presented in the new *Steam Power Plant Planning Guide* announced by Westinghouse Electric and Manufacturing Company. Part 1 of the new 40-page booklet illustrates types of turbines, and charts turbine sizes and speeds. Part 2 on performance data covers basic operating conditions, including effect of deviation in pressures and temperatures on heat rates, regenerative feedwater heating, recommended condenser sizes and condenser dimensions, condenser friction, impeller, propeller, and axial type circulating pumps, and condensate pumps. Data is presented in chart and table form for easy selection.

(32) *Excavating equipment*

In War and Peace is the title of a new booklet containing dramatic photographs of dozers, scrapers, dozershovels, and other tractor equipment in action on both the war and home fronts, published by Bucyrus-Erie Company, South Milwaukee, Wisconsin.

(33) *Bailey Pyrotron*

Bailey Meter Company, Cleveland 10, Ohio, has published Bulletin No. 230-A featuring Bailey Pyrotron electronic resistance thermometers in indicating, recording, and controlling models, for temperature ranges between the limits of minus 100°F. and plus 1200°F.

The instruments are said to be well suited for marine, mobile, or other classes of severe service since no galvanometers or millivoltmeters are used. No parts move in the measuring circuit except during temperature changes.

(34) *Centrifugal pumps*

A new bulletin on single suction pedestal type centrifugal pumps has been released by Allis-Chalmers Manufacturing Company, Milwaukee 1, Wisconsin. Developed for use where close-coupled motors were not practical, these Allis-Chalmers SS-B pumps are driven by electric motors, steam turbines, gasoline or diesel engines, direct-connected and through Texrope V-belts and flat belts.

(35) *Folder explains*

Successfully meeting the common problem of informing customers of the reasons why deliveries are slower than pre-war and creating a better understanding of the problems faced by the company, has been done by Western Gear Works with plants at Seattle, San Francisco, and Los Angeles. The firm recently issued a 4-page 2-color folder titled "Here Is Why," which does an unusually effective job of telling customers the reasons why prewar service is not possible. It explains the "special assignment" work being done on high priority aircraft, marine, and ordnance material. Straightforward, sincere copy is cleverly illustrated with cartoons. Copies of the folder are available.

(36) *Tube cleaning*

Correct steps to be taken before, during, and after a tube-cleaning operation to insure highest efficiency are outlined in a new service bulletin published by Thomas C. Wilson, Inc. Supplied in the form of a step-by-step check list, this information covers selection of appropriate equipment, proper cleaning procedure, care of cleaning equipment, and listings of types and sizes of motors, cutters, brushes, and other accessories required.

(37) *Welding alloys*

What are Eutectic low temperature welding alloys? A new and attractive four-page folder issued by th Eutectic Welding Alloys Company provides a complete answer to this question in simple, understandable terms, and explains EutecRods and EutecTrodes. Among the features claimed for the rods by the manufacturer are: Unusually low bonding temperatures that prevent distortion, less preheating of parent metal required, less after machining and cleaning, establishes a greater strength than brazing, with less rejects, and, insures a greater all around economy during use.

(38) *Self-priming pumps*

A most interesting and valuable handbook on pumps has been issued by Marlow Pumps of Ridgewood, New Jersey, entitled "Self-Priming Centrifugal Pumps." It is a definitive work on one of the most important pump developments of recent times. The treatise sets forth in easy-to-understand style, the principles of centrifugal action, the physics of pumping, and the evolution of self-priming centrifugal pumps. The handbook is scientific in content, but ingenious use of illustration and the use of simple, straightforward language make it a work that almost anyone can understand, profit by, and enjoy. The work was completed by A. S. Marlow, Jr., just before he entered the U. S. Navy.

(39) *Industrial coatings*

"No two men ever paint in the same manner," states the Carbozite Corporation, manufacturer of industrial coatings, in a new booklet giving instructions for applying protective coatings. Carbozite Corporation, therefore, has listed in its new manual directions and recommendations that have originated in their laboratories, where numerous coatings have been conceived and carried through many stages of testing and improvement. Upon completion of these laboratory tests, the coatings are then approved and submitted for marketing. Such thorough examination has demonstrated that when coatings are applied in a definite, prescribed manner, their protective value is increased.

(40) *Open heater*

Cochrane Corporation have released a bulletin treating on open feed water heaters of various types. Publication 4091 illustrates and describes different types of tray heaters for various applications, the jet heater, V-notch metering heater, also the convertible tray type of heater, which by the insertion of additional trays can be converted into a deaerator.

THE *Petroleum* Engineer's CONTINUOUS TABLES

A DAILY REFERENCE FOR OPERATING MEN

INSTALLMENT NO. 94

A VALUABLE and regular feature of *The Petroleum Engineer,* the Continuous Tables, now in their seventh year of publication, were designed to save time and effort for the technician and the practical field or plant worker. The tables have proved one of the most popular and helpful departments of *The Petroleum Engineer.* Data are presented in the simplest form available with many types of information included that are best presented by curves or nomographs when three or more variables must be considered simultaneously.

The Continuous Tables have developed as a result of suggestions for new tables, direct contributions, and improvements to existing tables by members of the petroleum and related industries, including manufacturing concerns, who are continually searching for practical information reduced by computation to tabular form readily applicable to the problems daily confronting them that might otherwise necessitate a more or less tedious calculation. These contributions and suggestions from the industry have resulted in a valuable exchange of information and data contributing to the progress of the industry as a whole.

This index will be revised monthly. The index for installments 1-12, inclusive, will be found in the May, 1938, issue; 13-24, inclusive, in the June, 1939, issue; 25-36, inclusive, in the June, 1940, issue; 37-48, inclusive, in the June, 1941, issue; 48-60, inclusive, in the June, 1942, issue; 61-72, inclusive, in the June, 1943, issue; 73-79, inclusive, in the January, 1944, issue; 80-82, inclusive, in the April, 1944, issue; 83-85, inclusive, in the July, 1944, issue; 86-88, inclusive, in the October, 1944, issue, and 89-91, inclusive, in the January, 1945, issue.

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His Fist

hit the desk

"If this company isn't using Gravel Packing to increase production and save repairs, we at least, ought to know why."

PARDON the big boss for being a bit emphatic, but he's right.

When a method has demonstrated its ability to maintain greater and longer lasting well production at *reduced* maintenance cost where loose producing sand is encountered, it should be thoroughly investigated.

Gravel Packing does just that:—

1. It saves both initial and replacement cost of expensive screens and liners.
2. It maintains a higher rate of flow.
3. It eliminates time off production for redrilling and clean out.
4. It saves costly and recurring pump and equipment repairs.

Can your company afford to lose these advantages?

TEXACO

TEXACO DEVELOPMENT CORPORATION

A Subsidiary of The Texas Company

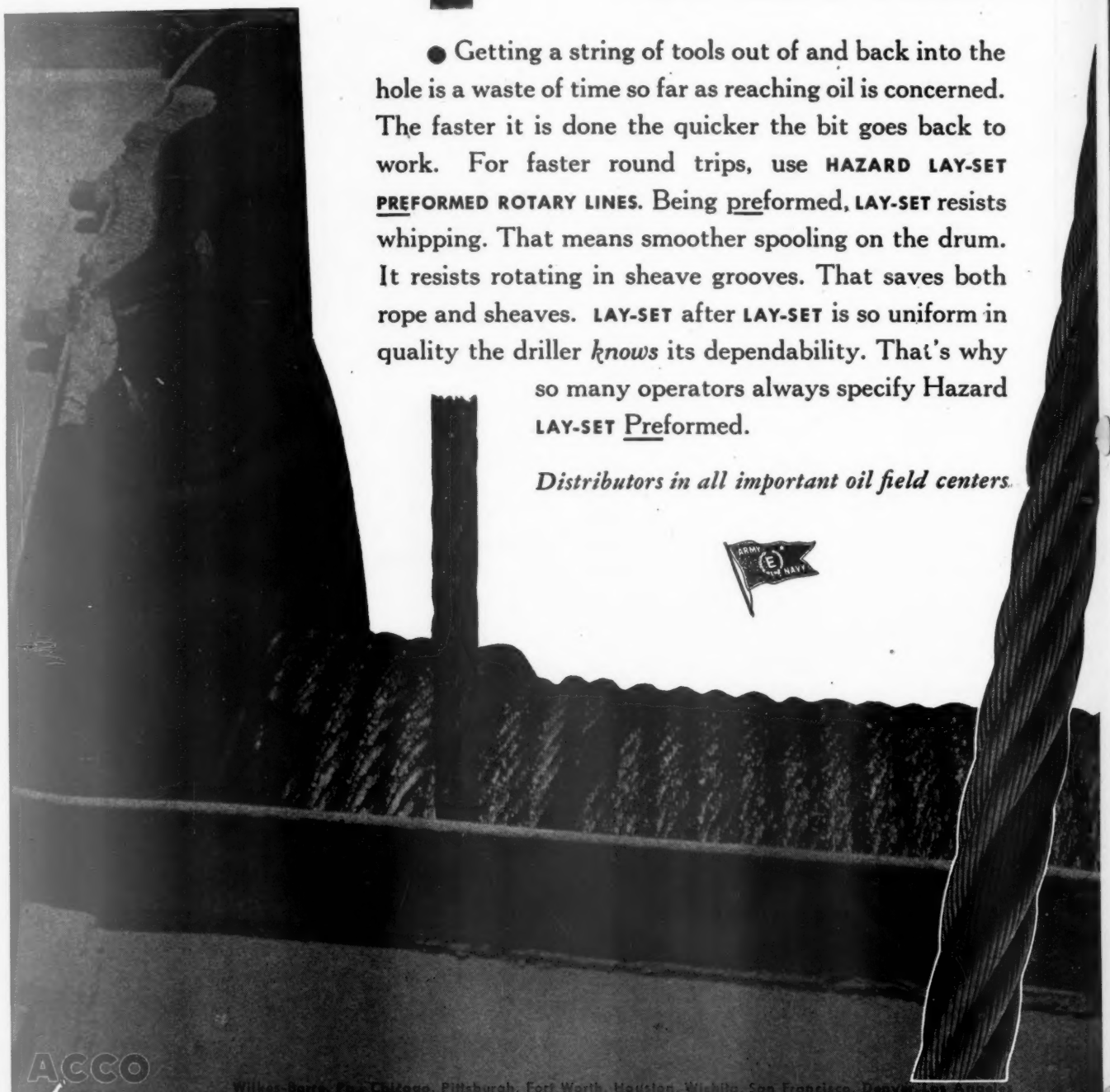
GAS-OIL RATIO CONVERSION TABLE

Gas-oil ratio (cu. ft./bbl.)	Yield (bbl./MMCF)	Content (gal./MCF)	Gas-oil ratio (cu. ft./bbl.)	Yield (bbl./MMCF)	Content (gal./MCF)
1.0	1,000,000.00	42,000.000	450.0	2,222.22	93.333
10.0	100,000.00	4,200.000	460.0	2,173.91	91.304
20.0	50,000.00	2,100.000	470.0	2,127.66	89.362
30.0	33,333.33	1,400.000	480.0	2,083.33	87.500
40.0	25,000.00	1,050.000	490.0	2,040.82	85.714
50.0	20,000.00	840.000	500.0	2,000.00	84.000
60.0	16,666.67	700.000	510.0	1,960.78	82.353
70.0	14,285.71	600.000	520.0	1,923.08	80.769
80.0	12,500.00	525.000	530.0	1,886.79	79.245
90.0	11,111.11	466.667	540.0	1,851.85	77.777
100.0	10,000.00	420.000	550.0	1,818.18	76.364
110.0	9,090.00	381.818	560.0	1,785.71	75.000
120.0	8,333.33	350.000	570.0	1,754.39	73.684
130.0	7,692.31	323.076	580.0	1,724.14	72.414
140.0	7,142.86	300.000	590.0	1,694.92	71.186
150.0	6,666.67	280.000	600.0	1,666.67	70.000
160.0	6,250.00	262.500	610.0	1,639.34	68.852
170.0	5,882.35	247.059	620.0	1,612.90	67.742
180.0	5,555.56	233.333	630.0	1,587.30	66.667
190.0	5,263.16	221.053	640.0	1,562.50	65.625
200.0	5,000.00	210.000	650.0	1,538.46	64.615
210.0	4,761.90	200.000	660.0	1,515.15	63.636
220.0	4,545.46	190.909	670.0	1,492.54	62.687
230.0	4,347.83	182.609	680.0	1,470.59	61.765
240.0	4,166.67	175.000	690.0	1,449.28	60.870
250.0	4,000.00	168.000	700.0	1,428.57	60.000
260.0	3,846.15	161.538	710.0	1,408.45	59.155
270.0	3,703.71	155.555	720.0	1,388.89	58.333
280.0	3,571.43	150.000	730.0	1,369.86	57.534
290.0	3,448.28	144.828	740.0	1,351.35	56.757
300.0	3,333.33	140.000	750.0	1,333.33	56.000
310.0	3,225.81	135.484	760.0	1,315.79	55.263
320.0	3,125.00	131.250	770.0	1,298.70	54.545
330.0	3,030.30	127.273	780.0	1,282.05	53.846
340.0	2,941.18	123.529	790.0	1,265.82	53.165
350.0	2,857.14	120.000	800.0	1,250.00	52.500
360.0	2,777.78	116.667	810.0	1,234.57	51.852
370.0	2,702.70	113.514	820.0	1,219.51	51.220
380.0	2,631.58	110.526	830.0	1,204.82	50.602
390.0	2,564.10	107.692	840.0	1,190.48	50.000
400.0	2,500.00	105.000	850.0	1,176.47	49.412
410.0	2,439.02	102.439	860.0	1,162.79	48.837
420.0	2,380.95	100.000	870.0	1,149.43	48.276
430.0	2,325.58	97.674	880.0	1,136.36	47.727
440.0	2,272.73	95.455	890.0	1,123.60	47.191

Example: 400 cu. ft./bbl.=2,500.00 bbl./million cu. ft.=105.000 gal./thousand cu. ft.

for faster round trips

HAZARD LAY·SET *Preformed* ROTARY LINES



● Getting a string of tools out of and back into the hole is a waste of time so far as reaching oil is concerned. The faster it is done the quicker the bit goes back to work. For faster round trips, use **HAZARD LAY-SET PREFORMED ROTARY LINES.** Being preformed, **LAY-SET** resists whipping. That means smoother spooling on the drum. It resists rotating in sheave grooves. That saves both rope and sheaves. **LAY-SET** after **LAY-SET** is so uniform in quality the driller *knows* its dependability. That's why so many operators always specify Hazard **LAY-SET** Preformed.

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ACCO

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HAZARD WIRE ROPE DIVISION

AMERICAN CHAIN & CABLE • BRIDGEPORT

ACCO TRADE MARK

In Business for Your Safety

PHYSICAL CONSTANTS OF HYDROCARBONS

Hydrocarbon	Specific gravity 20/4 °C.	M. P. °C.	B. P. °C.	Index of refraction n_D^{20}	Viscosity Abs. Poises	Spec. heat	Heat of vaporization Cal/G.	Heat of combustion K-Cal/mol.	Aniline point °C.	Coeff. of expansion °C.	Critical constants P Atms.	Critical constants T °C.	Critical constants D	Vapor pressure °C.	Vapor pressure mm.	Octane number Actual	Octane number Blending	Surface tension 20°C. Flash °C.
9–Octyl Heptadecane	0.8017	–13.8	184.0 (1.0)	1.4487	0.0893 (S) (37.8) 0.0249 (98.9)		63.1							172	0.5			
$C_{26}H_{54}$ Hexacosane	0.7580 (84)	56.4	268.0 (15)	14257 (84)	0.0656 (S) (60) 0.0242 (120)	0.5614 (61–85)		4161.4	118.0 (est)		10.9	583.0		259.4 286.4	11 30			24.79 (115.4)
5–Butyldocosane	0.8057	20.8	195.0 (1.0)	1.4503	0.1148 (S) (37.8) 0.0303 (98.9)		61.7		114.0					183.0	0.5			
7–Hexyleicosane	0.8040	10.2	194.0 (1.0)	1.4497	0.1069 (37.8) 0.0286 (S) (98.9)		62.7		114.4					181.0	0.5			
$C_{27}H_{56}$ Heptacosane	0.7609 (84)	59.1	277.0 (15)	1.4269 (84)				4320.6	120.0 (est)		10.7			268.4 294.6	11 30			
$C_{28}H_{58}$ Octacosane	0.7759 (70)	60.3	286.0 (15)	1.4270 (84)				4475.8	121.0 (est)		10.4	582.0		277.4 305.4	10 30			
$C_{29}H_{60}$ Nonacosane	0.7642 (84)	62.3	295.0 (15)	1.4285 (84)				4634.8	123.0 (est)		10.6			286.4 314.4	10 30			
$C_{30}H_{62}$ Triacontane (Myricyl)	0.7797 (65.9)	64.7	304.0 (15)	1.4348 (70)	0.0778 (S) (70) 0.0280 (130)	0.5722 (71–100)		4793.9	125.0 (est)		10.0	593.0		294.4 323.0	11 30			25.4 (100)
$C_{31}H_{64}$ Hentriacontane	0.7660 (84)	65.3	312.0 (15)	1.4356 (70)				4897.4	126.0 (est)					303.0 331.5	11 30			
$C_{32}H_{66}$ Dotriacontane (Dicetyl)	0.9439	69.6	320.0 (15)	1.4315 (84)	0.0766 (80) 0.05359 (100)			5055.8p	127.6 (est)	0.000853 (75–100)	9.5	609.0		311.0 349.5	11 30			27.2 (73.2)
11–Decyldocosane	0.8127	1.0	235.0 (1.0)	1.4543	0.1653 (S) (37.8) 0.0392 (98.9)		57.1		123.1					222.0	0.5			30.2
$C_{33}H_{68}$ Tritriacontane	0.7695 (84)	71.1	328.0 (15)	1.4316 (84)		0.463 (21.4)		5266.4						319.0 347.4	11 30			
$C_{34}H_{70}$ Tetratriacontane	0.7706 (84)	72.3	336.0 (15)	1.4323 (84)		0.572 (l)		5366.3			8.8	620.0		326.5 355.4	11 30			

See table P 771.001. B for footnotes.

Table from "Physical Constants of the Principal Hydrocarbons," by M. P. Doss, 4th edition, by courtesy of copyright owner, The Texas Company.

This Simple Compressor Meets the Complex Needs of a Changing Petroleum Industry

It's the Nash!

Here is a compressor presenting advantages found in no other device. Nash Compressors have only one moving part, rotating without metallic contact with the pump casing. No internal lubrication is required. Yet they produce 75 lbs. pressure in a single stage, with capacities to 6 million cu. ft. per day in a single structure.

There are no valves, gears, pistons, sliding vanes, or other complicated wearing parts in a Nash. Compression is secured by an entirely different principle of operation. Because of this, gas pumping problems difficult with ordinary pumps are often easily handled by the Nash. For example, Nash Pumps are standard equipment in the Synthetic Rubber Industry, where they have met the needs of new and difficult processes.

Nash Compressors are compact and save space. They run without vibration, and compression is without pulsation. They maintain original performance over long periods. Service is assured by a nationwide net-work of Engineering Service offices. Instructive bulletin shows how they operate. Write for it.

One moving part.

No internal wearing parts.

No valves, pistons, or sliding vanes.

No internal lubrication.

Low maintenance.

Slugs of liquid entering pump do no harm.

Non-pulsating pressure.

Saves floor space.

75 pounds in a single stage.

NASH ENGINEERING COMPANY

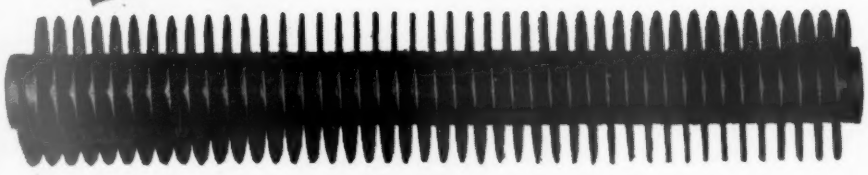
272 WILSON, SO. NORWALK, CONN.

PHYSICAL CONSTANTS OF HYDROCARBONS

Hydrocarbon	Specific gravity 20/4 °C.	M. P. °C.	B. P. °C.	Index of refraction n_D^{20}	Viscosity Abs. Poises	Spec. heat	Heat of vaporization Cal/G.	Heat of combustion K-Cal/mol.	Aniline point °C.	Coeff. of expansion °C.	Critical constants P Atms.	Critical constants T °C.	Critical constants D	Vapor pressure °C. mm.	Octane number Actual	Octane number Blending	Surface tension 20°C. Flash °C.
$C_{35}H_{72}$ Pentriacontane	0.7727 (84)	74.4 74.6	281.0 (2)	1.4333 (84)		(l) 0.565		5522.6						315.5 . 5.17 332.2 10.34			
$C_{36}H_{74}$ Hexatriacontane	0.7795 (82)	76.0	265.0 (1)	1.4341 (82)				5678.9	132.8		8.5	648.0					27.48 (84)
$C_{37}H_{76}$ Heptatriacontane	0.768 (100)	77.4		1.4328 (90)				5835.2									
$C_{38}H_{78}$ Octatriacontane	0.7688 (100)	77.1		1.4326 (90)				5991.5									
$C_{39}H_{80}$ Nonatriacontane	0.7771 (84)	78.8		1.4359 (84)				6147.8									
$C_{40}H_{82}$ Tetracontane	0.7785 (84)	81.3	.0001 mm. 150.0	1.4365 (84)				6304.4			8.1	670.0					
$C_{41}H_{84}$ Hentetracontane	0.7784 (84)	80.7		1.4366 (84)				6460.7									
$C_{42}H_{86}$ Dotetracontane	0.7803 (84)	82.9		1.4375 (84)				6617.0									
$C_{43}H_{88}$ Tritetracontane	0.7810 (84)	84.95–85.15	236.0 (1)	1.4378 (84)	0.0668 (75) 0.0409 (100)			6773.3									
$C_{50}H_{102}$ Pentacontane	0.7490 (92.1)	91.9–92.3	.00001 mm. 200.0					7871.4			6.8	708.0					
$C_{60}H_{122}$ Hexacontane	0.7465 (115.4)	98.5–99.3	.00001 mm. 250.0						168.0		6.0	782.0					24.18 (115.4)
$C_{70}H_{142}$ Heptacontane		105.0–105.5	.00001 mm. 300.0														
$C_{26}H_{54}$ 6, 11-Diamyl-hexadecane	0.8068	−16.2	182.0 (1.0)	1.4502	0.118 (S) (37.8) 0.0274 (98.9)		58.0		112.0					169.0 0.5			
$C_{28}H_{58}$ 9-Octyl-eicosane	0.8074	0.5	211.0 (1.0)	1.4513	0.1203 (S) (37.8) 0.0310 (98.9)		64.0		117.2					199.0 0.5			

See table P 771.001. B for footnotes.

Table from "Physical Constants of the Principal Hydrocarbons," by M. P. Doss, 4th edition, by courtesy of copyright owner, The Texas Company.



Lowest vapor pressure loss through the shell . . .

Fewest tubes for a given duty . . .

Least possibility of leakage . . .

Rated capacity maintained for long periods without requiring tube cleaning . . .

Speediest and easiest cleaning . . .

These five features of the K-Fin Vapor Heat Exchanger warrant your further study of this unit for services such as transfer of heat between heavy oil vapor under vacuum and furnace charge.

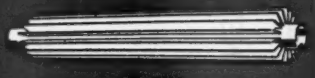
Complete information is contained in our Bulletin 1625, copy of which will be sent on request.

THE GRISCOM-RUSSELL CO.
285 Madison Ave., New York 17, N. Y.

GRISCOM-RUSSELL
Pioneers in Heat Transfer Apparatus

ONLY G-R BUILDS THIS WIDE VARIETY OF HEAT TRANSFER APPARATUS

SHELL and BARE TUBE
Heaters, Coolers, Condensers, Heat Exchangers



G-FIN
Longitudinal-finned elements for greater heat conductivity

K-FIN
Helical-finned elements for vapors and gases

BENTUBE SECTIONS
with scale-shedding elements for brackish or salt water

TUBULAR SECTIONS
Non-clogging design for residuum and other dirty fluids

GAS-OIL RATIO CONVERSION TABLE

Gas-oil ratio (cu. ft./bbl.)	Yield (bbl./MMCF)	Content (gal./MCF)	Gas-oil ratio (cu. ft./bbl.)	Yield (bbl./MMCF)	Content (gal./MCF)
900	1,111.11	46.667	1500	666.67	28.000
910	1,098.90	46.154	1520	657.89	27.632
920	1,086.96	45.652	1540	649.35	27.273
930	1,075.27	45.161	1560	641.03	26.923
940	1,063.83	44.681	1580	632.91	26.582
950	1,052.63	44.210	1600	625.00	26.250
960	1,041.67	43.750	1620	617.28	25.926
970	1,030.93	43.299	1640	609.76	25.610
980	1,020.41	42.857	1660	602.41	25.301
990	1,010.10	42.424	1680	595.24	25.000
1000	1,000.00	42.000	1700	588.24	24.706
1010	990.09	41.584	1720	581.40	24.419
1020	980.39	41.176	1740	574.71	24.138
1030	970.87	40.777	1760	568.18	23.864
1040	961.54	40.385	1780	561.80	23.596
1050	952.38	40.000	1800	555.56	23.333
1060	943.40	39.623	1820	549.45	23.077
1070	934.58	39.252	1840	543.48	22.826
1080	925.93	38.888	1860	537.63	22.581
1090	917.43	38.532	1880	531.91	22.340
1100	909.09	38.182	1900	526.32	22.105
1110	900.90	37.838	1920	520.83	21.875
1120	892.86	37.500	1940	515.46	21.649
1130	884.96	37.168	1960	510.20	21.429
1140	877.19	36.842	1980	505.05	21.212
1150	869.57	36.522	2000	500.00	21.000
1160	862.07	36.207	2025	493.83	20.741
1170	854.70	35.897	2050	487.80	20.488
1180	847.46	35.593	2075	481.93	20.241
1190	840.34	35 294	2100	476.19	20.000
1200	833.33	35.000	2125	470.59	19.765
1220	819.67	34.426	2150	465.12	19.535
1240	806.45	33.871	2175	459.77	19.310
1260	793.65	33.333	2200	454.55	19.091
1280	781.25	32.813	2225	449.44	18.876
1300	769.23	32.308	2250	444.44	18.667
1320	757.57	31.818	2275	439.56	18.462
1340	746.27	31.343	2300	434.78	18.261
1360	735.29	30.882	2325	430.11	18.065
1380	724.64	30.435	2350	425.53	17.872
1400	714.29	30.000	2375	421.05	17.684
1420	704.23	29.577	2400	416.67	17.500
1440	694.44	29.167	2425	412.37	17.320
1460	684.93	28.767	2450	408.16	17.143
1480	675.68	28 378	2475	404.04	16.970

Example: 1200 cu. ft./bbl.=833.33 bbl./million cu. ft.=35.000 gal./thousand cu. ft.

The Deeper You Go the More You Need UNIFORM STRENGTH

● The greater setting depths of the future, the longer casing strings required, and the higher pressures you'll encounter demand a casing with high strength. That's why we stress the fact that *every square inch* of *every length* and *every joint* of Republic Electric Weld Casing and Tubing is Uniformly Strong.

You can be sure of that quality from the way Republic Casing is made—formed from flat-rolled steel of uniform strength—welded by an improved electric weld process that assures a weld as strong as the wall—and every foot fully normalized.

This is another reason why more than 100,000,000 feet of Republic Electric Weld Casing and Tubing have given such dependable service.

REPUBLIC STEEL CORPORATION
GENERAL OFFICES • CLEVELAND 1, OHIO
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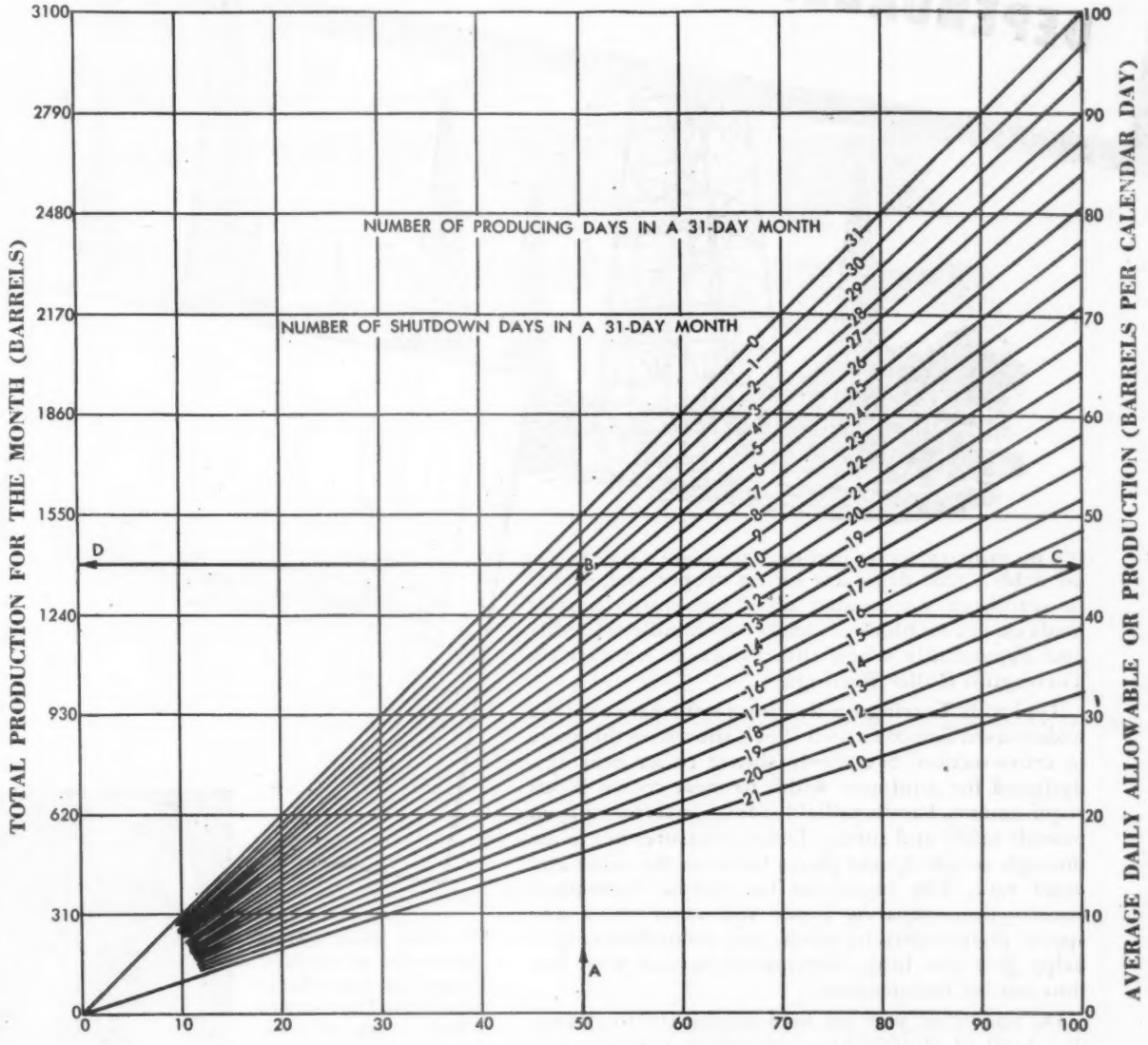
REPUBLIC
LINE PIPE
NORMALIZED CASING AND TUBING

Other Republic Products Include Alloy Steels —

CHART FOR ESTIMATING EFFECT OF SHUTDOWN DAYS ON AVERAGE DAILY PRODUCTION IN A 31-DAY MONTH



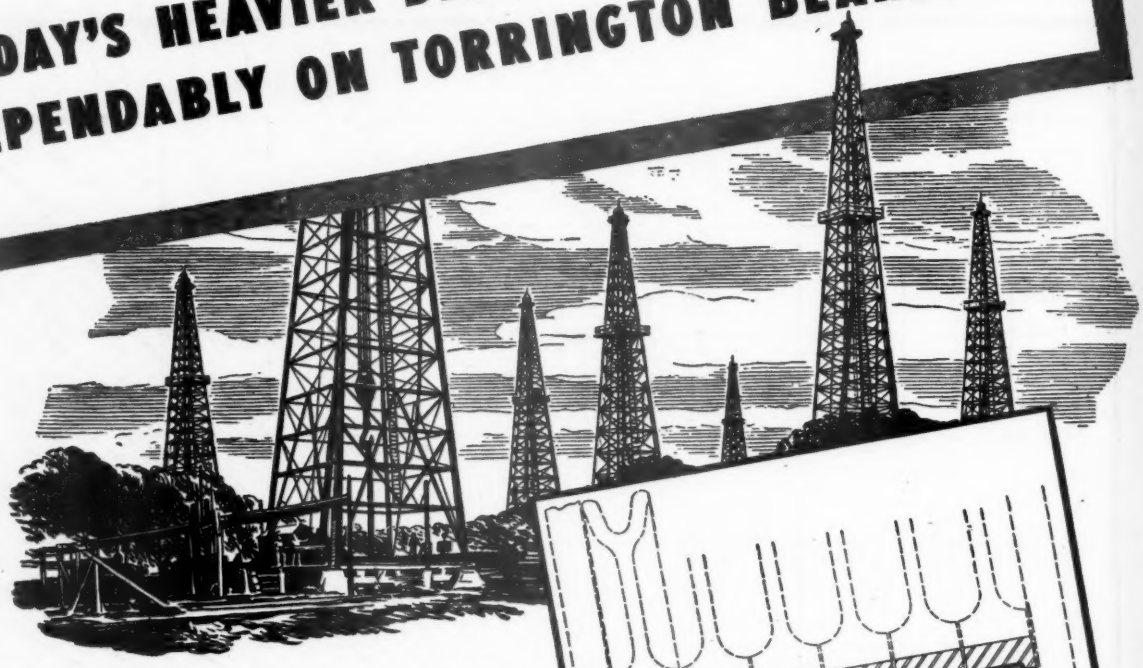
EXAMPLE:

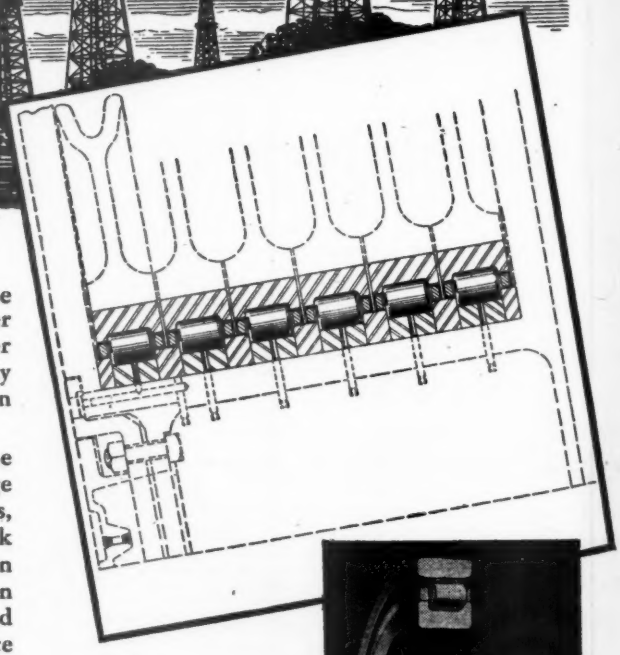
Given: A basic (or scheduled) allowable of 50 bbl. subject to 3 shutdown days during a 31-day month.

Solution: Starting at the 50 mark on the basic allowable scale (point A), move up to the intersection of the 50-bbl. line with the diagonal 3-day shutdown line (point B). Then, lay a straight edge horizontally through the point of intersection (B) and read the average daily allowable on the right-hand scale at the point of intersection (C) = 45 bbl. per calendar day.

Next read the total production for the month on the left-hand scale at point of intersection (D) = 1400 bbl.

TODAY'S HEAVIER DRILL STRINGS HANDLE DEPENDABLY ON TORRINGTON BEARINGS



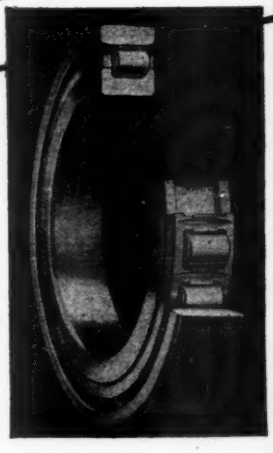


It's no military secret that the "pressure's on" in the oil fields...that drills are biting deeper and deeper in search of war-needed oil. That means heavier loads on crown blocks...loads they handle smoothly *and dependably* when their sheaves operate on Torrington Roller Bearings.

Typical is Torrington Bearing performance on the widely-used Emsco Crown Block shown on this page in cross-section. Six sturdy sheave roller bearings, designed for minimum width to meet crown block requirements, handle radial loads of a quarter-million pounds safely and surely. Thrust pressures are taken through simple spacer plates between the inner and outer race. The ingenious but simple three-piece construction—separate inner and outer races and spacer plates—permits quick, easy reconditioning... helps give you long, dependable service with less time out for maintenance.

Do you want *your* oil field machinery to deliver that kind of trouble-free, *dependable* performance? The engineers of Torrington's Bantam Bearings Division will gladly cooperate with yours to incorporate those and other Torrington advantages into the equipment you design, build or operate.

X-section shows typicat application of compact, rugged Torrington Roller Bearings to Emsco Crown Block . . . one of many Torrington Bearing applications to oil field machinery.

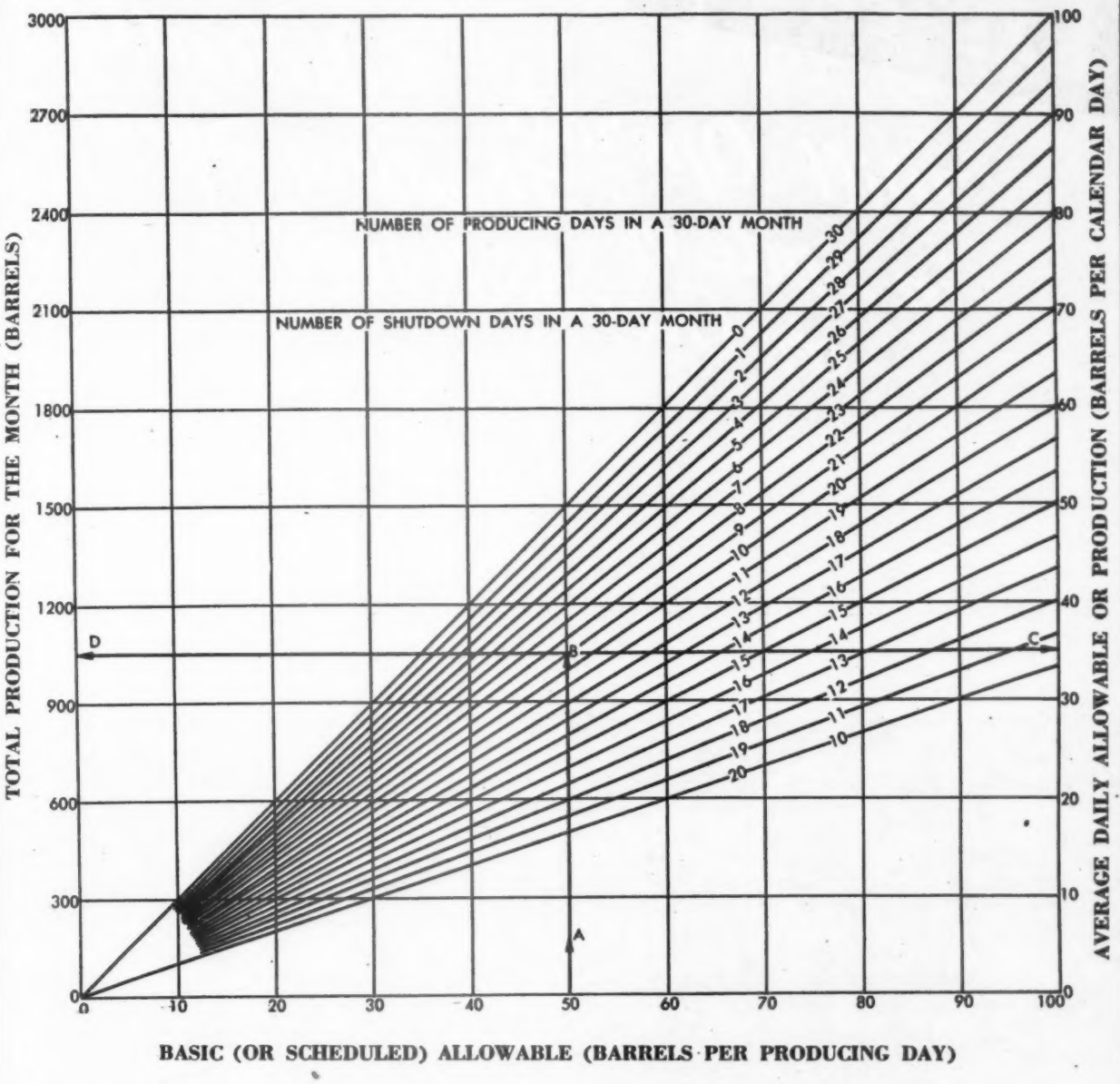


THE TORRINGTON COMPANY · BANTAM BEARINGS DIVISION
SOUTH BEND 21, INDIANA

TORRINGTON BEARINGS

STRAIGHT ROLLER • TAPERED ROLLER • NEEDLE • BALL

CHART FOR ESTIMATING EFFECT OF SHUTDOWN DAYS ON AVERAGE DAILY PRODUCTION IN A 30-DAY MONTH

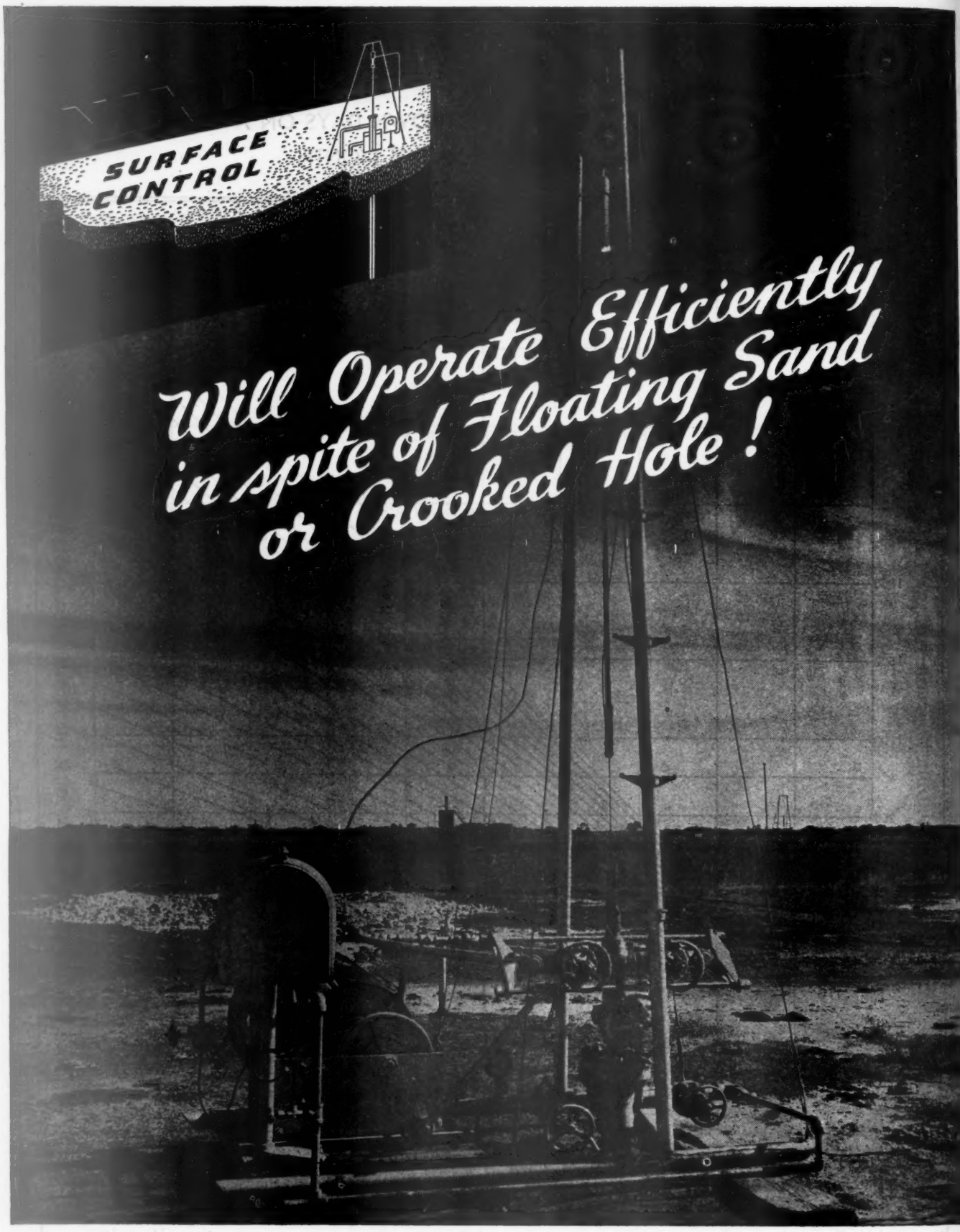

TOTAL PRODUCTION FOR THE MONTH (BARRELS)
AVERAGE DAILY ALLOWABLE OR PRODUCTION (BARRELS PER CALENDAR DAY)
BASIC (OR SCHEDULED) ALLOWABLE (BARRELS PER PRODUCING DAY)
NUMBER OF PRODUCING DAYS IN A 30-DAY MONTH
NUMBER OF SHUTDOWN DAYS IN A 30-DAY MONTH
0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20
30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10
A
B
C
D
0 300 600 900 1200 1500 1800 2100 2400 2700 3000
0 10 20 30 40 50 60 70 80 90 100

EXAMPLE:

Given: A basic (or scheduled) allowable of 50 bbl. subject to 9 shutdown days during a 30-day month.

Solution: Starting at the 50 mark on the basic allowable scale (point A), move up to the intersection of the 50-bbl. line with the diagonal 9-day shutdown line (point B). Then, lay a straight edge horizontally through the point of intersection (B) and read the average daily allowable on the right-hand scale at the point of intersection (C) = 35 bbl. per calendar day.

Next read the total production for the month on the left-hand scale at point of intersection (D) = 1050 bbl.



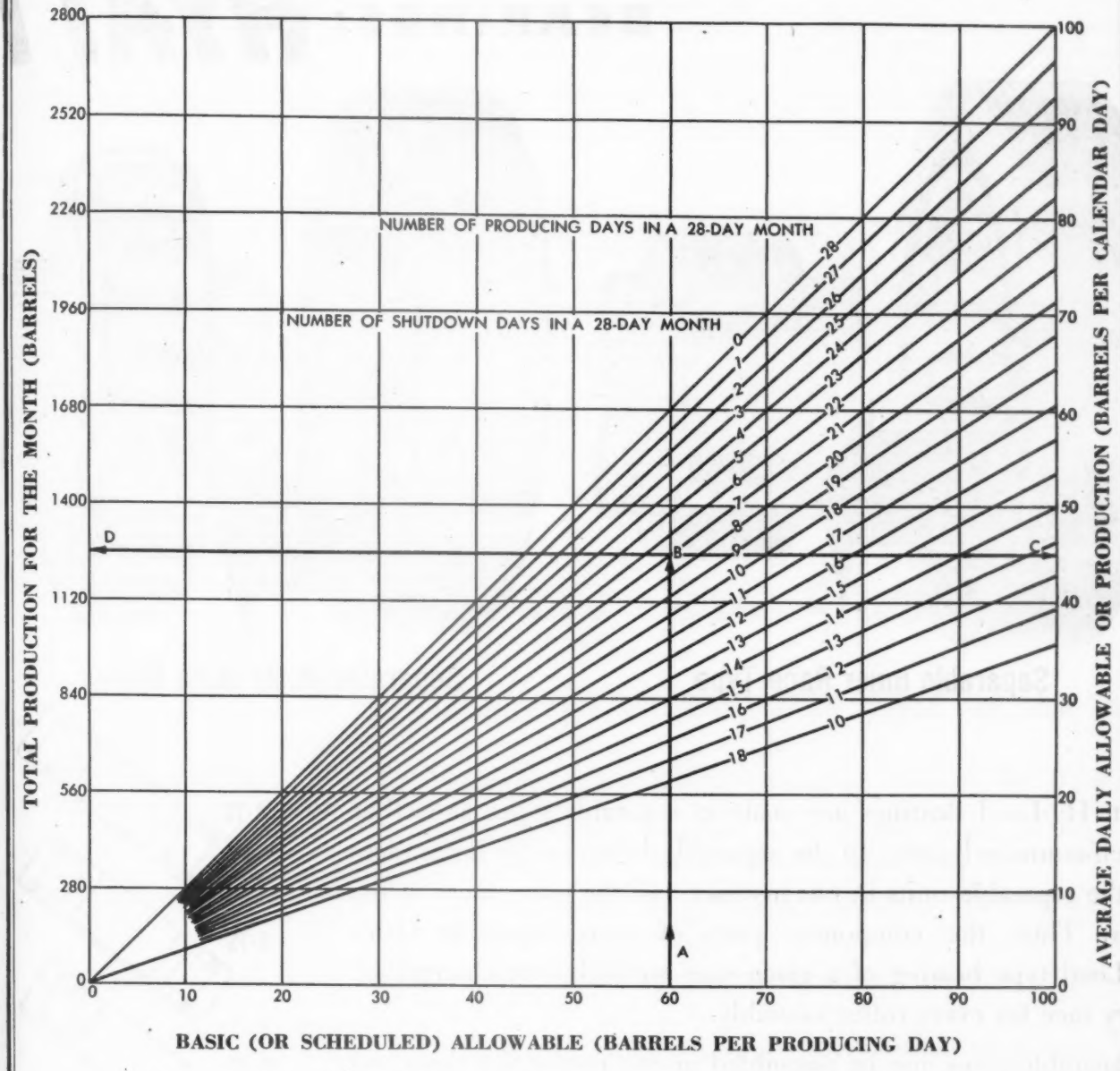
WILSON SUPPLY COMPANY

1412 MAURY STREET . . . HOUSTON, TEXAS

SALES OFFICES: Tulsa, Oklahoma; Dallas, Beaumont, and San Antonio, Texas. LOS ANGELES: Western Pressure Control, 5700 Santa Fe Ave. TRINIDAD, B.W.I.: Neal Massey Eng. Corp.

BRANCH STORES: Texas—Gladewater, Barbers Hill, Bay City, Monahans, Alice, Victoria, Corpus Christi. LOUISIANA—Lake Charles, New Iberia, Harvey, Shreveport. ARKANSAS—Magnolia. MISSISSIPPI—Natchez.

CHART FOR ESTIMATING EFFECT OF SHUTDOWN DAYS ON AVERAGE DAILY PRODUCTION IN A 28-DAY MONTH



EXAMPLE:

Given: A basic (or scheduled) allowable of 60 bbl. subject to 7 shutdown days during a 28-day month.

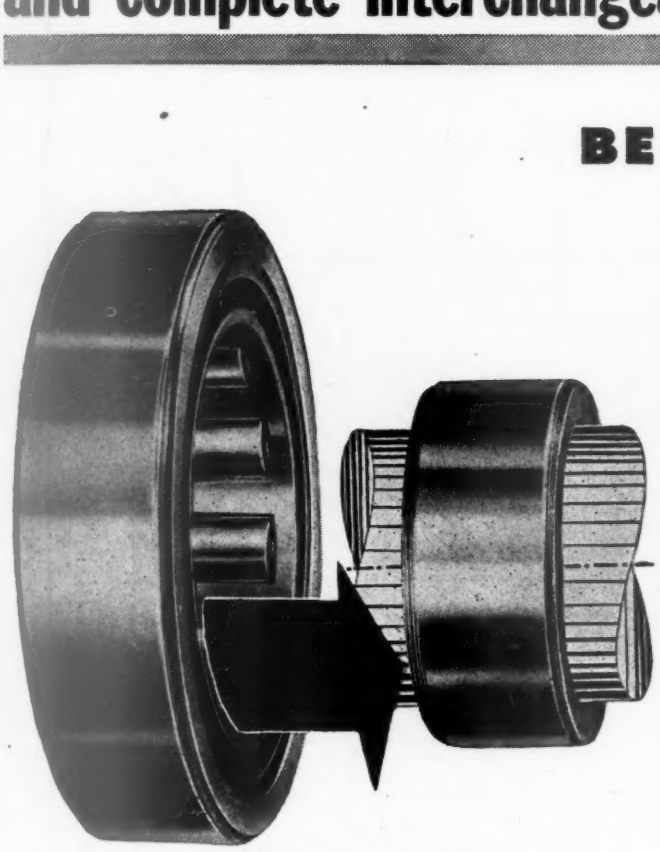
Solution: Starting at the 60 mark on the basic allowable scale (point A), move up to the intersection of the 60-bbl. line with the diagonal 7-day shutdown line (point B). Then, lay a straight edge horizontally through the point of intersection (B) and read the average daily allowable on the right-hand scale at the point of intersection (C) = 45 bbl. per calendar day.

Next read the total production for the month on the left-hand scale at point of intersection (D) = 1260 bbl.

SIMPLICITY in machine design

and complete interchangeability of component parts

BEARINGS: HYATT



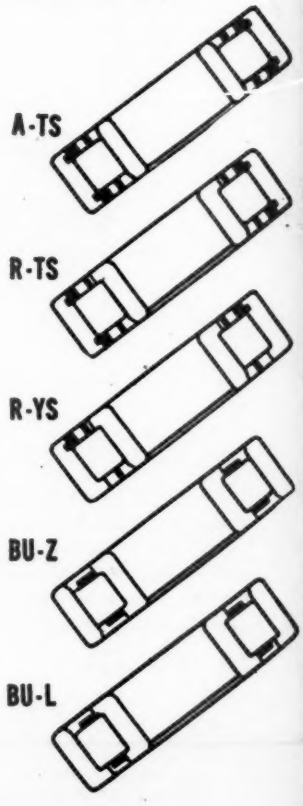
Separable Inner Race Type

Separable Outer Race Type

Hyatt Hy-Load Bearings are made in separable types as well as in self-contained units. In the separable bearings the inner races are the separable units in one instance and the outer races in the other. Thus, the component parts of every separable Hyatt Hy-Load type bearing of a given size are fully interchangeable. Every race fits every roller assembly.

Separable races may be assembled in one part of the shop and the rest of the bearing in another. When the sub-assemblies are brought together on the final assembly line the component bearing parts will fit correctly. No selection or matching required.

Every Hyatt A-TS, R-TS, R-YS, BU-Z and BU-L type bearing has this feature—and many others. Write for data.



HYATT BEARINGS DIVISION · GENERAL MOTORS CORPORATION

HARRISON NEW JERSEY · CHICAGO · DETROIT · PITTSBURGH · OAKLAND, CALIFORNIA

Promoted by Girdler

L. E. Osmer has been appointed sales manager of The Girdler Corporation's Gas Processes Division, it is announced by W. R. Wood, vice president.

Osmer attended the University of Michigan, where he received his B. S. degree in mechanical engineering in 1923. He began his business career with the Semet Solvay Engineering Corporation, as cadet engineer, in 1923. For 4 years he was a construction superintendent for the firm, and in 1928 was promoted to the sales engineering staff. From 1930 until 1943, when he joined the Gas Processes Division of The Girdler Corporation, he was Semet Solvay's district representative for the midwest, with headquarters in Chicago.

Larkin anniversary

Larkin Packer Company, Inc., completed its 40th year as a manufacturer of specialized oil industry equipment early in April. On April 5, 1905, John J. Larkin founded the company with a lit-

W. H. Larkin

J. J. Larkin, Jr.

tle shop in Bartlesville, Indian Territory, from which point a comparatively small area in the upper Mid-Continent was served.

A native of Butler, Pennsylvania, where his father, W. H. Larkin, Sr., established Larkin and Company in 1873, John J. Larkin spent his entire life serving the oil industry. Several of his developments in equipment have represented major steps in the progress of safe drilling and production practices. He died in October, 1944, and was succeeded as president of the company by his son, W. H. Larkin. A second son, J. J. Larkin, Jr., is vice president in charge of the company's engineering and plant production. Mrs. L. G. Dancy has been renamed secretary and treasurer.

From their large, modern plant in St. Louis, the company today ships a large line of specialty equipment to fields throughout the world.

New Cummins building

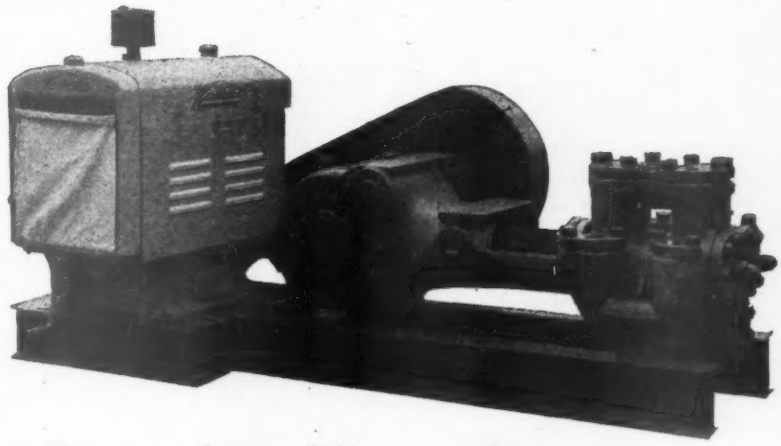
Largely as the result of the urgent need in the oil fields for additional powered drilling rigs, the War Production Board has authorized the Cummins Engine Company, Inc., Columbus, Indiana, to begin work immediately on the construction of a new building that will enable the company to double its production of the heavy-duty Model L Cummins diesel.

Although a certain portion of the increased output will be earmarked for locomotives, construction, logging and mining equipment, fishing boats and work boats, most of the engines will go into new drilling equipment destined for service in producing areas and also for wildcatting operations.

The project will cost $625,000 and will be financed entirely by the company. Although details regarding construction have not been disclosed, the building will be a fireproof, one-story structure, modern in every detail. Overall dimensions are 80 ft. wide by 470 ft. long, providing an additional 35,000 sq. ft. of floor space. It will be erected on the site of a factory parking lot, next to the injector and fuel pump building. Company officials expect the new addition to be completed and ready for use by the third quarter of 1945.

The Model L Cummins diesel is a 6-cylinder, 7-in. by 10-in., medium speed engine of 2309 cu. in. piston displacement, which develops its maximum 250 hp. output at 1000 r.p.m.

BUY WAR BONDS



Half the Job . . .

Is Having the RIGHT PUMP UNIT for the Job!

THE Fairbanks-Morse Power Pump IS RIGHT

This Duplex Self-Oiling Power Pump No. 6181 is Tandem Mounted with Waukesha Motor . . . other makes and models of motors available.

It's a 4 x 6-inch delivering 93 GPM with a maximum pressure of 300 lbs. per square inch at 75 RPM.

Special features are the Herringbone gears, Roller Bearings for Crank and Pinion Shaft.

All sizes of Fairbanks-Morse pumps and engines available through United Supply.

IMMEDIATE DELIVERY FROM STOCK AT OUR FIELD STORES

Courtesy . . . Service . . . Dependability

United SUPPLY AND MANUFACTURING COMPANY

UNITED SUPPLY AND *Manufacturing* COMPANY

Main Office: TULSA, OKLAHOMA

Smelting facilities

The Harshaw Chemical Company with headquarters in Cleveland, Ohio, has authorized the construction of a new antimony smelter and oxide plant at its El Segundo, California, works.

The plant is now being designed and construction has begun by Southwestern Engineering Company of Los Angeles, California. R. A. Lucht, assistant chief engineer of the Harshaw Chemical Company, is acting as technical adviser, with Harold B. Menardi, manager of the local division of the company, in direct charge of the project.

Construction is expected to be completed in July of this year. The completion of this smelter will add materially to southern California's production of refined metal products.

Forms new division

Formation of an aviation gas turbine division for the manufacture of military and, later, commercial gas turbine aircraft engines, based on the jet engine already developed by Westinghouse for the navy, is announced by L. E. Osborne, vice president.

Reporting that Westinghouse research engineers had developed the first wholly American design of jet propulsion aircraft engine to be tested in flight, Osborne said the new engine is expected to produce more propulsive thrust for its weight than any other aircraft engine built to date. It will power combat aircraft of the U. S. Navy.

Manager of the new manufacturing division, which will have its headquarters at the Westinghouse South Philadelphia works, is George H. Woodard, formerly manager of the company's new products division at East Pittsburgh, Pennsylvania.

W. F. Boyle, who formerly coordinated gas turbine activities within the steam division, has been named sales manager of the new division.

Reinout P. Kroon, who as manager of development engineering in the steam division headed a staff of engineers instrumental in the design of the new jet engine, has been named manager of the engineering department.

Samuel S. Stine, formerly assistant works manager of the steam division, will be manager of manufacturing for the aviation gas turbine division.

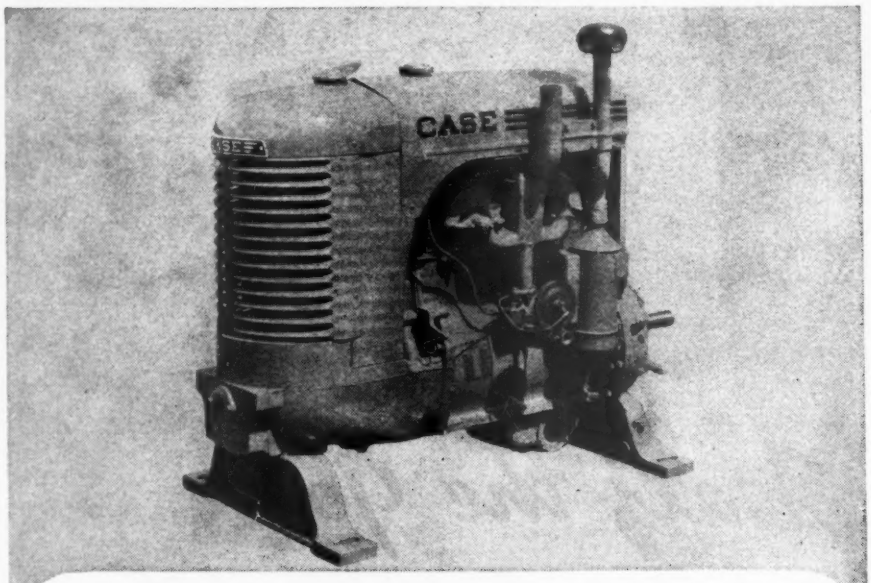
Killed in action

Word has been received from the Navy Department that Lt. John B. Warren, Jr., has been killed in action in the Pacific.

Lt. Warren was born in Houston, Texas, on July 3, 1912. He attended Virginia Military Institute and subsequently entered Rice Institute from which he was graduated in 1933. Upon graduation he entered the employ of the Humble Oil and Refining Company, in the engineering department, resigning in 1934 to pursue post-graduate work in the University of California. In 1935 he entered the employ of the Quintana Petroleum Company and was stationed at Refugio, Texas, as a tool pusher, until 1937. While at Refugio he invented a machine, called the "Mud-O-Graf," for automatically determining and recording the specific gravity of drilling mud. In 1939 he organized the Warren Automatic Tool Company, for the marketing of the "Mud-O-Graf" and other oil field specialties of which he was the inventor.

Lt. J. B. Warren, Jr.

Lt. Warren held the office of president with the Warren Automatic Tool Company since the company was chartered in 1939.



RUNS A LONG WHILE

...Without Pampering

CONTINUOUS operation counts when you want all the oil you can get out of a well. The way that Case oilfield engines keep going . . . often for months and sometimes for years . . . without shutdown helps make the most of oil resources. Because they need no coaxing and but little routine care, they make the most of manpower resources, too. This endurance . . . earmark of Case power . . . is not born of novel features, but of more than seventy years of experience in building sturdy engines for outdoor work.

If you have Case engines, don't overplay your luck; be sure they get regularly the little attention they require. If you need new pumping power, see if your Case distributor can supply you. Case oilfield engines are built in 30, 49 and 68 horsepower sizes, and may be equipped for liquid or gaseous fuels, or both. J. I. Case Co., Racine, Wis.

DISTRIBUTORS

Southwest Machinery Company, 1900 Linwood Boulevard, Oklahoma City, Okla.
Wm. K. Holt Machinery Company, San Antonio, Texas
Southwest Equipment Company, Dallas and Kilgore, Texas

FULL GAUGE HOLE—ALL THE WAY

MODEL 8447

SIMPLE DESIGN

FEW PARTS

NO "HANGING-UP"

NO STUCK CASING

RUGGED CONSTRUCTION

POSITIVE EXPANSION

INSURES FULL GAUGE HOLE

Grant
ROLLER CUTTER UNDERREAMER

The GRANT Underreamer is rugged in construction and dependable in operation. The positive expanding action and the provision of dual cutters on each cutter assembly assures full gauge hole, which is a guarantee for the fast, safe landing of the casing string. Expansion is sufficient to allow a thick cement sheath around the casing to assure a good water shut-off. It is widely used for side-tracking junk or "fish" lost in the hole. • The GRANT Underreamer is designed and built to underream hard and abrasive formations that required rock bits in drilling. • It is a "trouble-free" tool. Cutters are always in a collapsed position until expanded by the pumps, and may be opened or closed at will anywhere in the hole—without coming out of the hole. Cutter assemblies are securely locked within the body, preventing loss of parts in the hole. The cutter assemblies are free with relation to both the body and mandrel, so that any upward pull collapses the cutters for removal without danger of jamming in the hole.

USED WHERE PERFORMANCE COUNTS

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LOS ANGELES 11, CALIFORNIA

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Please send me, without obligation, complete information on the GRANT Tools checked below.

NAME..... TITLE.....

COMPANY.....

ADDRESS.....

CITY..... STATE.....

☐ Bailers ☐ Cleaners ☐ Hole Enlargers ☐ Liner Pullers
☐ Reamers ☐ Shale Bits ☐ Underreamers ☐ Wall Scrapers
☐ Safety Automatic Pressure Releases (Mud Pumps)

Dresser N. Y. offices

The opening on March 15 of consolidated domestic and export sales offices for the member companies of Dresser Industries, Inc., at 800 Chanin Building, New York City, is announced by H. N. Mallon, president.

Fifteen offices, in addition to a reception room, conference room, and stenographic room, occupy 6000 sq. ft. of floor space and will also provide New York headquarters for visiting officers of Dresser member companies. An auditorium seating 250 persons is additionally available in the building for sales conferences and other meetings.

Modern efficiency in layout and lighting is the keynote of the space to be occupied. Equipped with every modern time-saving device for improved processing and handling of orders, the sales offices of the Dresser member companies formerly located individually throughout the New York business district will benefit by the combined facilities and central location represented in this new space. The new offices will also afford closer coordination, and be of advantage to customers and distributors interested in the related products of Dresser Industries, Inc., it is announced.

Sales departments of Dresser member companies serving the fields of oil and gas from production to utilization, and represented in the newly opened New York offices, will be the Dresser Manufacturing Division, Bryant Heater Company, Clark Bros. Co., Inc., Pacific Pumps, Inc., International Derrick and Equipment Company, Roots-Connersville Blower Corporation, and Stacey Bros. Gas Construction Company.

Reopens office

The Chicago Bridge and Iron Company has reopened its Los Angeles office at its location, Room 1105, William Fox Building.

The office is in charge of Dean E. Stephen who, for the last several years, has been assistant to James C. Vosburgh, manager of the Chicago Bridge and Iron Company's office in Washington, D. C. Before going to Washington, Stephen was a member of the companys' Birmingham sales office staff.

Army-Navy "E" award

Inspiring ceremonies marked the presentation of the Army-Navy Production Award to the Marmon-Herrington Company recently in formal recognition of its notable record in the production of war equipment.

Presentation of the award was made at the company's plant on West Washington Street, Indianapolis, by Colonel J. C. Shouvlin, chief of the Cincinnati ordnance district. Arthur W. Herrington, chairman of the board of directors at Marmon-Herrington, accepted the award on behalf of the company and employes. The Navy Department was represented by Lt. Commander R. W. MacGregor, resident inspector of naval materiel, Indianapolis, who presented the management and employes with Army-Navy 'E" pins. Charles Inman, chairman UAW-CIO Marmon-Herrington unit, accepted the pins in behalf of the employes.

Executive passes

Walter Ewing Miller, former vice president, treasurer, and director of Fairbanks, Morse and Company, Chicago, and a director of Canadian-Fairbanks-Morse Company, Ltd., Montreal, died in Chicago recently after a brief illness at the age of 81.

Miller, at the age of 23, joined the Fairbanks-Morse organization, January 15, 1887, when the company was a partnership. Later he became one of the original incorporators with Charles Hosmer Morse in 1891. He served the company in various executive capacities for nearly 43 years, retiring from active duty in 1929.

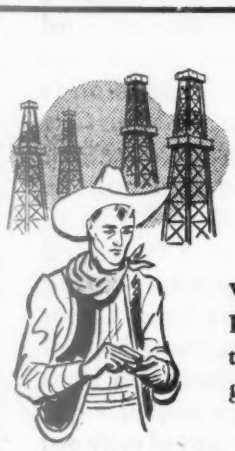
Merritt promoted

Floyd C. Merritt, long identified with the production phases of the oil industry, was elected a vice president of Byron Jackson Company at a recent meeting of the company's directors.

Merritt, a 1910 graduate of Stanford University, majored in geology, and in 1912 made the first exploration of Venezuela's Maracaibo basin. During the succeeding 10 years he served as a geological consultant in many fields of the Western Hemisphere.

Floyd C. Merritt

On January 1, 1922, he joined J. E. (Brick) Elliott in the formation of the Elliott Core Drilling Company serving as vice president and general manager until its acquisition by Byron Jackson Company in 1939. Transferring to the latter company, he served as works manager of the oil tool division and in other important executive capacities until his recent elevation to a vice presidency.



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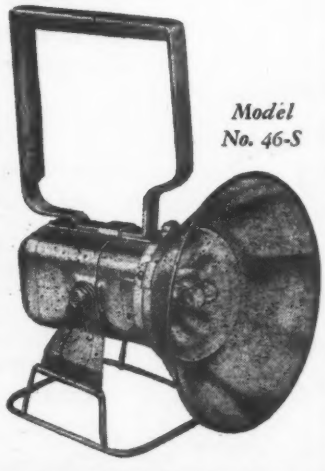
JUSTRITE *for Safety*

When men in the field who use Justrite Safety Products say they're "copacetic" you can bet they're okay for the oil fields are tough proving grounds for any product.

INSPECTOR'S SAFETY LANTERN

Model No. 46-S



A Justrite electric lantern designed for general inspection work. It has "kick-out" bulb sockets and sparkproofed guard . . . and is approved for safety by the U. S. Bureau of Mines for safe use in methane gas and air mixtures. Twin-bulbs guard against the hazards of light failure. Large fixed handle for carrying over the arm provides two hand grips. Polished 7-inch reflector can be removed or replaced easily. A powerful light that's guaranteed for safety . . . Justrite.

Ask at supply companies about Justrite Safety Products.

JUSTRITE MANUFACTURING COMPANY 2063 N. Southport Avenue Dept. G-2, Chicago 14, Ill.

BUY WAR BONDS

Joins Pressure Weld

E. P. Jones, formerly development engineer with The Linde Air Products Company, has resigned to join the Pressure Weld Company, Houston, Texas, with the position of general superintendent.

Jones has been closely associated with the development of the pressure weld process since its introduction by The Linde Air Products Company.

Lunkenheimer elects

At the annual meeting of The Lunkenheimer Company, Cincinnati, Ohio, the following officers and directors were elected: Frank P. Rhame, president and general manager; Homer E. Lunken, first vice president and assistant general manager; Harry A. Burdorf, vice president, sales; Charles W. Burrage, secretary; and Chester C. Isekeit, treasurer and controller. Directors are Harry A. Burdorf, Henry G. Frost, Chester C. Isekeit, Carl M. Jacobs, Edmund P. Lunken, Homer E. Lunken and Frank P. Rhame.

Grizzly plans

Grizzly Manufacturing Company, which just previous to the outbreak of the war went into production in its new brakelining plant at Paulding, Ohio, now announces the sale of its rubber division in Los Angeles to the Thermoid Company of Trenton, New Jersey. It is stated that by this transaction, Grizzly withdraws from oil field activity.

Grizzly personnel will remain unchanged, according to Joe Brown, general sales manager, but from now on will concentrate all its engineering, manufacturing, and marketing abilities upon automotive and industrial friction products, friction blocks, brake linings, and clutch facings.

Junior AIME meeting

Douglas Jones was the speaker at the March meeting of the Southern California Junior AIME Division. The subject was "Fundamentals of Sucker-Rod Pumping."

Jones outlined modern rod design. The theoretical behavior of sucker-rod systems was discussed in detail, and the talk was illustrated with a simple model. Equations for calculating peak loads and minimum loads were compared. Jones stated that in the absence of considerable experience and data, the simple equations were more satisfactory for everyday use. The fundamentals of stress failure in fibers alternately in tension and compression were reviewed and the application of the cycle-stress function to correct rod design was illustrated by charts. Rods subject to corrosion or having local imperfections will fail more rapidly under tension-compression cycles and do not have a stress range at which an almost unlimited number of reversals may be had without failure, Jones said.

The World's Standard of Quality in Oil Field Equipment - - -

Acme — Since 1900

Pattin — Since 1888

TWO "OLD RELIABLES" NOW ONE

ACME DRILLING & FISHING TOOLS

PATTIN BROS. DIVISION of Acme Fishing Tool Co.

Pattin *Ruggedness*— a Tradition Gone Modern

There are many "performing examples" of Pattin RUGGEDNESS in the Oil Country that are now serving ***well*** their ***second generation*** of owners. Thus it is established fact that Pattin Engines, Powers and Compressors are built for ***life-long*** dependable, economical service.

It would be amazing to know the revolutions those "Old Timers" have made and the equivalent in "road mileage" — compared with the ***potential*** of present-day ***high-speed*** units.

While adhering to the Pattin ***tradition*** — that RUGGEDNESS is the ***safest*** foundation for enduring efficient, economical performance in oil field equipment — improvements in design and operational refinements have kept pace through the years.

Guided by long experience and a firm conviction that comparative slow speed, single cylinder, heavy-duty engines ***deliver*** far more ***power,*** at much less cost, over the long pull — meaning greater hole footage drilled or volume of oil lifted — we continue to ***specialize*** in them.

*(**Note:** Supporting our "stick-to-itiveness" and prediction is the new trend toward slower speed units — as revealed by our recent visits to principal fields.)*

PATTIN BROS. ENGINES
POWERS — COMPRESSORS

Wear More— "Drilmor"

Acme Drilling Jars: Famous since 1900 for their longer wear, as measured by footage of hole drilled. Forged only of correct jar steel, meeting Acme's rigid specifications for ***proper*** heat treatment — by long-seasoned craftsmen especially skilled in jar making. Furnished in either Rein Welded type (Fig. 107) or "Drilmor" Weldless.

Fig. 107
See
Acme — Composite Catalog.

"GLUTTONS for Life-Long Punishment"

Write TODAY for New Catalog

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PARKERSBURG, W. VA.

PATTIN BROS. DIV.
of Acme Fishing Tool Co.
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Export Office: 19 Rector St., New York 6, N. Y.

Chemists to meet

Members of government agencies, as well as distinguished chemists, are expected to discuss chemistry's ever-increasing importance to the winning of the war at the May 11 Medal Meeting of the American Institute of Chemists, to be held in Columbus, Ohio. The program is under the direction of the Miami Valley Chapter of the Institute.

The recipient of the 1944 Gold Medal Award is John W. Thomas, chairman and chief executive of The Firestone Tire and Rubber Company. Thomas, former chief chemist of Firestone, has played an important part in establishing chemical research as a major arm of industry. The award is in special recognition of his "executive ability in translating research results into large-scale production, which was a major aid in the development of America's giant wartime synthetic rubber industry."

The opening of the new $2,000,000 Firestone research laboratory, built under Thomas' direction, is scheduled for May 12.

The award will be made by Dr. Gustav Egloff, president of the Institute and research director of Universal Oil Products Company.

Dr. E. L. Luaces, chairman of the Miami Valley Chapter of the Institute and president of the Chemical Developments Corporation of Dayton, Ohio, is in charge of the arrangements of the Medal Meeting. Dr. James R. Withrow, head of the Chemical Engineering Department of Ohio State University, is honorary chairman.

Address change

Foote Bros. Gear and Machine Corporation, Chicago, Illinois, announces a change in address of their Pittsburgh sales representative, the W. G. Kerr Company, effective April 20. The new location is 520 Oliver Building, Pittsburgh 22, Pennsylvania. William G. Kerr and Robert J. Beler are principles of the Kerr company representing Foote Bros. speed reducers and industrial gears in western Pennsylvania.

New publication

The first issue of Westinghouse *Newsfront*, a new monthly publication by the Westinghouse Electric and Manufacturing Company, appeared in April.

The four-page report, printed in two colors and illustrated with drawings and photographs, contains short articles describing the latest achievements by the company in the fields of scientific research, engineering and production. Featured in the first issue are a round-up on the company's annual report to stockholders, a story on a new application of the Precipitron air-cleaner for the removal of fly-ash, and a picture page illustrating recent Westinghouse developments.

Requests to be placed on the mailing list should be addressed to the Editor, Westinghouse *Newsfront*, 306 Fourth Avenue, Box 1017, Pittsburgh, Pennsylvania.

Lane-Wells changes

John J. Neale has been made Gulf Coast division sales manager of Lane-Wells Company, technical oilfield services, according to an announcement of the management. For the last 3 years Neale was district superintendent of the company's Louisiana operations with headquarters at New Iberia.

Lee J. Lobdell is superintendent of the newly established Laurel district with headquarters at Laurel, Mississippi. A new operating point has been established at Natchez, Mississippi, with F. E. Senyard as operator in charge. B. G. Dunlap succeeds Lobdell as sub-district superintendent at Longview, Texas.

Other changes include J. M. Henderson succeeding Neale as district superintendent at New Iberia. G. A. Harris succeeding Henderson as assistant district superintendent. V. E. Campbell is promoted from sales engineer, Houston district, to sub-district superintendent at Houma, Louisiana. H. W. Greene moves to Lake Charles as sub-district superintendent.

J. Murray Walker has been transferred to Tulsa, Oklahoma, as division sales engineer. S. W. McGaha has been moved to Oklahoma City as district superintendent and Charles B. Snodgrass to Salem, Illinois, as district superintendent.

THEY LIKE IT!

Yes sir! AMERICAN HEAVY DUTY ROLLER BEARINGS are made to take all you can give them—and more! Put them to the most abusive, gruelling service you can think of . . . in the heaviest, most powerful equipment built . . . and they'll carry the load smoothly and easily, with minimum maintenance for maximum periods, often outlasting the equipment itself. No wonder AMERICAN HEAVY DUTY ROLLER BEARINGS are specified by most major manufacturers and designers of heavy industrial machinery.

AMERICAN ROLLER BEARINGS HEAVY DUTY

Write today for complete engineering data

AMERICAN ROLLER BEARING COMPANY

PITTSBURGH, PENNSYLVANIA

Pacific Coast Office: 1718 S. Flower St., Los Angeles, Calif.

AMERICAN
Heavy-Duty ROLLER BEARINGS

WHEN MERCY SPEEDS ON WHIRLING WINGS

Flood, storm, forest fire or a major accident often maroons victims in inaccessible country, far from relief so urgent in saving lives.

Tomorrow's helicopters will find one of their most vital uses in such emergencies. They can go straight up or down, and fly swiftly forward. If it were necessary, they could even "*stand still in the air*", only a few inches above ground, to unload relief cargo, or take aboard ill or injured persons.

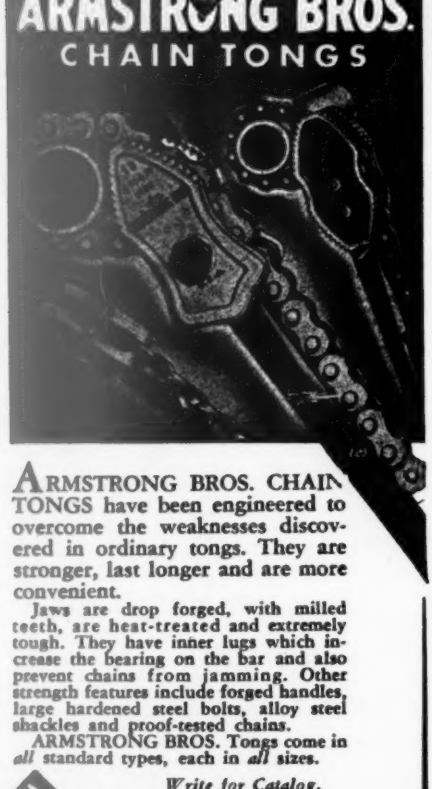
Under war stimulus, with Government encouragement, great strides have been made in the development of helicopters. They can serve a wide range of activities, from crop-dusting to exploration in regions where no other craft can land or take off. Kellett engineers have had an important part in this evolution. They are preparing now for the time when helicopters will perform many of the challenging tasks of peace, the world over.

THIS FREE BOOKLET TELLS YOU

If you wish to have more information about this new empire of "flight without wings," just write for "Answering Some Helicopter Questions". Kellett Aircraft Corporation, Dept. N, Upper Darby . (Philadelphia), Pa.

KELLETT

OLDEST ROTARY WING AIRCRAFT MANUFACTURING COMPANY



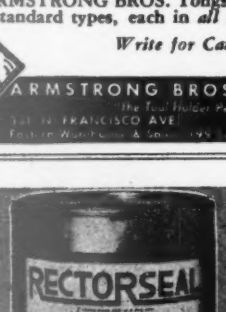
ARMSTRONG BROS. CHAIN TONGS have been engineered to overcome the weaknesses discovered in ordinary tongs. They are stronger, last longer and are more convenient.

Jaws are drop forged, with milled teeth, are heat-treated and extremely tough. They have inner lugs which increase the bearing on the bar and also prevent chains from jamming. Other strength features include forged handles, large hardened steel bolts, alloy steel shackles and proof-tested chains.

ARMSTRONG BROS. Tongs come in *all* standard types, each in *all* sizes.

Write for Catalog.

ARMSTRONG BROS. TOOL CO.
"The Tool Holder People"
CHICAGO, U.S.A.



INSOLUBLE

In All Petroleum Products

You can use RECTORSEAL on all connections with complete assurance of a permanent positive seal. It is a chemical compound, insoluble in all petroleum products. It is unaffected by salt water, dilute acids and steam up to 400 degrees F.

Use RECTORSEAL on mud, oil, water, steam or gas line connections, and you never have to worry about leaks.

When applied it forms a plastic, elastic mass which quickly seals . . . and holds indefinitely. It does not freeze or gall. Connections are quickly and easily broken-out, even after many months of service.

Apply RECTORSEAL on every connection . . . threaded or gasket. Get RECTORSEAL from your nearest supply store.

RECTOR WELL EQUIPMENT COMPANY, INC.
FORT WORTH, TEXAS
Export: Lucey Export Corp., Woolworth Bldg., N. Y. C.

RECTORSEAL
THE POSITIVE LEAK PREVENTER

Tide Water Elects

H. S. Chase, vice president in charge of manufacturing, eastern division, and Drew L. Hines, vice president in charge of the transportation and supplies department, eastern division, have been elected directors of Tide Water Associated Oil Company, according to an announcement by William F. Humphrey, president.

K. R. Hankinson, vice president and treasurer, has been appointed a member of the eastern division operating committee.

Both Chase and Hines have had more than 22 years' continuous service with the company.

According to Humphrey's announcement, Hines was also appointed vice chairman of the eastern division operating committee, of which B. I. Graves is chairman.

Idea awards

The Empire, Cities Service Oil Company house magazine, will announce in its April issue that special awards totaling $350 will be presented to Oscar Ledbetter of Ponca City, Oklahoma, Earl Y. Palmer of Holdenville, Oklahoma, and Lewis Scott of Ponca City in recognition of their "outstanding" suggestions submitted in 1944 for improvement of company operations and earnings.

The special awards are in addition to the regular awards presented to the three men by the company's suggestions committee, through which all suggestions pertaining to operations, company earnings, and safety are processed.

The first prize award of $200 presented to Ledbetter, who is a pipe fitter at the Ponca City refinery, was for his suggestion that a specially-designed truck, equipped with filters, be used to salvage breeze coke, a critical war material, during the "coking out" process. The filter-equipped truck will salvage approximately 365 tons of the critical war material per year at the Ponca City refinery and, in addition, will save much-needed manpower formerly needed in this operation. The suggestion will be applied to operations at the company's refinery at East Chicago, Indiana.

The $100 second place award to Palmer, who is employed at the Cities Service crude chemical plant at Sasakwa, Oklahoma, was based on substantial savings in manpower and a safety factor.

Palmer, in a move that was beyond his line of duty, designed an air nozzle that feeds a better mixture of air and gas into the combustion chamber utilized in the manufacture of formaldehyde crude. The old-type nozzle clogged up at intervals and it was periodically necessary to dislodge the rust and particles by the "blow-back" method. Although the new nozzle does not completely eliminate the necessity of "blow backs," the number has been reduced materially. The device will be utilized at the company's four crude chemical plants in Oklahoma.

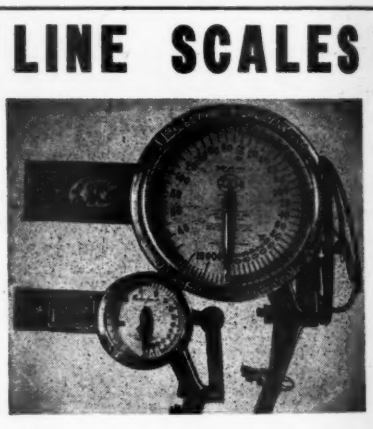
Lewis Scott of the Ponca City refinery, winner of the $50 special award, devised a screening arrangement in the

"Best Bet Yet"

These oil-proof, wear-resistant, plastic tubing protectors are an integral part of the tubing collar. Made in all sizes, they prevent the metal-to-metal contact that has caused many expensive "wet" jobs in pumping wells in the past.

PATTERSON-BALLAGH TUBING PROTECTORS
LOS ANGELES 1 • HOUSTON 10 • NEW YORK 6

LINE SCALES



20 MODELS to choose from

(Above) Super 500,000# capacity, 14" dial. (Below) Packer Special, Capacity 40,000#, 6" dial. 18 other models for every drilling, well servicing, or work-over need.

With a Line Scale you know the pull on the line, and the weight on the bit in pounds. Accurate, sensitive, rugged, durable and economical.

Although we are working at top capacity to supply ship yards and the U. S. Navy —we are still able to furnish Line Scales to the oil industry. Write for folder and prices.

LINE SCALE CO., Inc.
Phone 2-1765, 907-11 SE 29th St., Box 4245
Oklahoma City, Oklahoma

steamer tower at the contact plant, where oil is treated, that prevents clogging up of sewer lines and the fouling of pump valves with coke particles. Use of the suggested screening arrangement eliminates a number of shut downs per year involving substantial savings and also damage to war-scarce pumps.

The three suggestions that won special awards were selected from suggestions submitted by employes during the last year in 26 states and Canada. Awards averaging $18.30 per suggestion accepted were paid out in war bonds and war stamps.

CFEA officers

The Chemical Fire Extinguisher Association, at its recent annual meeting held in Chicago, reelected the following officers: President, Arthur G. Sullivan, vice president, Buffalo Fire Appliance Corporation, Buffalo, New York; vice president, J. O. Binford, general sales manager, American-La France-Foamite Corporation, Elmira, New York; treasurer, Herman W. Diener, secretary, George W. Diener Manufacturing Company, Chicago, Illinois, and commissioner, W. J. Parker, W. J. Parker, Inc., New York City.

Directors reelected at the meeting are George H. Boucher, general sales manager, Pyrene Manufacturing Company, Newark, New Jersey, and E. A. Warren, vice president, General Detroit Corporation, Detroit, Michigan.

Named to committee

Robert P. Russell, president of Standard Oil Development Company, has been named a member of the nine-man civilian committee to appraise results of strategic air bombing in Europe, according to a recent War Department announcement.

Standard Oil Development Company is the central research organization for Standard Oil Company (New Jersey) affiliates.

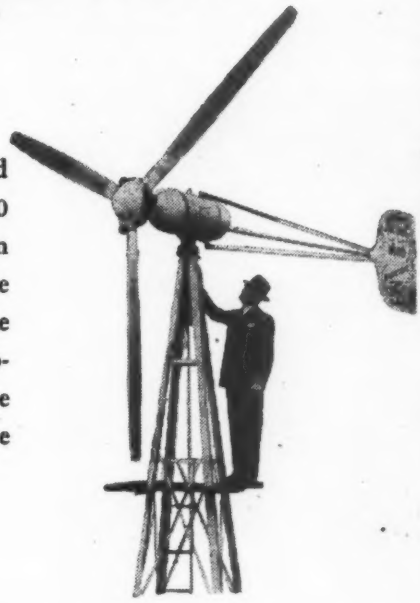
The new committee, known as the United States Strategic Bombing Survey, will analyze the effect of air bombardment on the will and capacity of the enemy to resist. Information will be gathered with the aid of the military services by means of field operations throughout the European battle areas.

Since the outbreak of war, Russell has devoted much of his time to governmental work with the Office of Scientific Research and Development and the National Defense Research Committee. He has had an important part in development of new weapons using petroleum products—the famous M-69 oil incendiary bomb; the M1-A1, and other model flamethrowers, and the oil smoke generator. He has been closely identified with developments in 100-octane gasoline, synthetic rubber, and synthetic toluol for TNT.

BUY WAR BONDS

PIPE LINE CORROSION
JACOBS WIND ELECTRIC PLANTS
New Improved 1945 Model
2 Sizes — 1200 and 2000 Watts
10 to 40 Volts

The new Jacobs Cathodic Wind Electric Plants represent nearly 10 years of manufacturing research in this field. Wherever reasonable wind conditions prevail, these plants will profitably retard corrosion. Practically no maintenance attention is required. They are fully automatic in operation.



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Pipe Line Division: MINNEAPOLIS 11, MINNESOTA, U.S.A.
America's Oldest Manufacturer of Wind Electric Plants

OPERATING AIR COMPRESSOR

WISCONSIN
HEAVY-DUTY
Air-Cooled
ENGINES
on the job

A typical oil field operation for Wisconsin air-cooled engines is this air compressor assignment on a location near Anamas Pass, Texas. This heavy-duty, single cylinder engine can be depended upon to keep on "pumping air" hour after hour, day after day without layups or need for servicing. Complete freedom from cooling attention and troubles is a point that merits a little extra consideration during times like these . . . or *any time*, for that matter. In a power range of 1 to 30 hp. there is a Wisconsin air-cooled engine of the right type and size for a great variety of oil field applications.

MOST POWER PER POUND

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Corporation
MILWAUKEE 14, WISCONSIN
World's Largest Builders of Heavy Duty Air-Cooled Engines

WRITE TO HARLEY SALES CO.
510 Atlas Building, Tulsa, Oklahoma
M & M Building, Houston, Texas
Oil field distributors for Wisconsin Engines and all types of utility units.

General sales manager

A. Leschen and Sons Rope Company, St. Louis, Missouri, has announced the appointment of Douglas W. Vernon as general manager of sales. Vernon is an experienced wire rope man, having been connected with the industry for the last 20 years.

Douglas W. Vernon

J. L. Ashley passes

James Lincoln Ashley, a director of The International Nickel Company of Canada, Ltd., died March 6 in New York.

Ashley was formerly secretary and treasurer of The International Nickel Company of Canada, Ltd., and vice president and treasurer of The International Nickel Company, Inc., the United States subsidiary.

Born in New York on October 14, 1869, he spent his youth in that city. His first business connection was with Joseph Wild and Company of New York, where he remained until 1902. He became associated with mining and metallurgy when the International Nickel Company was organized in 1902. He served first as assistant to the late Colonel Ambrose Monell, the president, and thereafter was successively assistant secretary, secretary and treasurer. In the corporate reorganization in 1928, he was elected to the position of secretary and treasurer in the parent company and vice president and treasurer of its United States subsidiary.

President of galvanizers

Clem Stein, manager of industrial sales of the International Derrick and Equipment Company, Columbus, Ohio, one of the Dresser Industries, has been elected president of the American Hot Dip Galvanizers Association.

The association, dedicated to the interests of the job galvanizing industry, is recognized by government agencies as spokesman for the industry. Through its close cooperation with the War Production Board, a highly successful zinc conservation program has been carried out that insures an adequate supply of this critical material for all essential needs with the minimum of paperwork.

Profit-sharing fund

Officials of Fairbanks, Morse and Company, Chicago, have announced that more than three-quarters of a million dollars have been set aside out of 1944 profits to be distributed to eligible employes under the company's profit-sharing plan. The exact amount totaled $776,880.16.

Named manager

Harold D. Powell has been named division tubular manager for the Mid-Continent Supply Company and will make his headquarters at the company's general offices, Mid-Continent Building, Fort Worth, Texas.

H. D. Powell

Powell is well known in the oil well supply business, having had many years' experience, and previously has supervised Mid-Continent's field operations in various territories.

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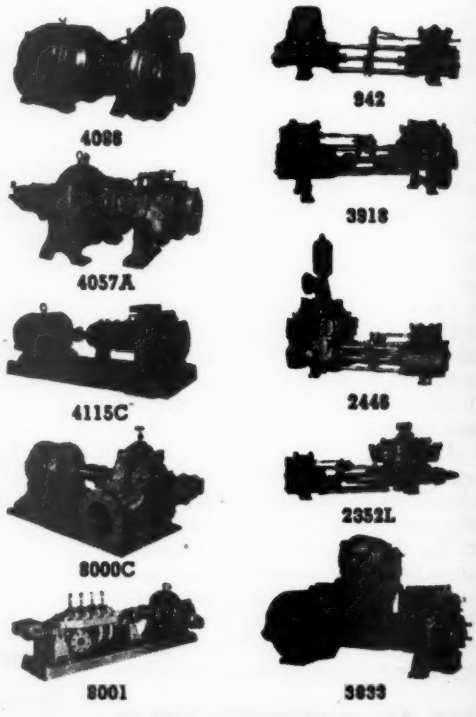

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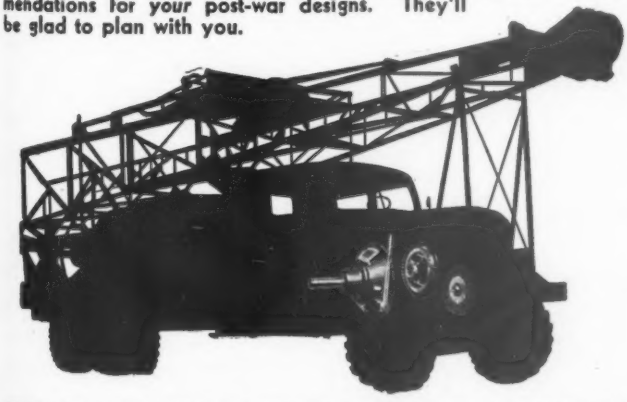
Because of the wide variety of experience and clutch building facilities at their command, our engineers are solving the most difficult power transmission control problems. They can help *you* avoid LOST reconversion TIME on either standard or out-of-the-ordinary clutch applications. Arrange *now* to benefit from their clutch recommendations for *your* post-war designs. They'll be glad to plan with you.



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It shows typical installations of ROCKFORD CLUTCHES and POWER TAKE-OFFS. Contains diagrams of unique applications. Furnishes capacitity tables, dimensions and complete specifications. Every production engineer will find help in this handy bulletin, when planning postwar products.

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Drill Pipe FAILURES DUE TO FATIGUE CAN BE PREVENTED with PERIODIC INSPECTION

Many twist-offs and subsequent expensive fishing jobs may be averted by the location of minute fatigue cracks or other discontinuities in drill pipe, tool joints and other highly stressed drilling equipment and the rejection or salvage of that part. A high percentage of such defects are not to be found through visual inspection.

Now, through American Inspection Service's completely equipped mobile field unit, periodic inspection of such equipment can be made by the

MAGNETIC PARTICLE METHOD

This method has been proved in industry for the past 15 years but has heretofore been limited to plants having high voltage current. Perfection of our mobile unit, however, now makes possible the same precision inspection in the petroleum field at the well, pipe rack or overhaul shop.

Indication of a tight lipped crack in drill pipe, undetected in visual inspection but easily located by the Magnetic Particle Method.

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MECHANICAL GUARDIANS FOR ALL KINDS OF PIPE LINES

In chemical industries, synthetic rubber plants, oil refineries . . . any plant, piping precious or potentially hazardous fluids . . . a mistake, whether unintentional or deliberate, in adjusting a pipe-line valve can prove both dangerous and costly. But prevention of these human errors is easy and infallible with BENDIX-CORY* SAFETY INTERLOCKS . . . the locks that say "No!" to unauthorized handling of your valves.

The BENDIX-CORY SAFETY INTERLOCK illustrated gives absolute control over the opening and closing of the valve to which it is attached . . . and, by use of an interlock key, can also control the position of this valve in relation to any number of other valves. The unit is wholly mechanical, and fully adjustable to compensate for valve wear—one of a number of interlocks specially designed for valve protection.

BENDIX-CORY SAFETY INTERLOCKS are dependable guardians for your pipe lines. Write for full information.

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CHECK THESE FEATURES

- ✓ Interlocks stem valves 2" to 8". Other interlocks for globe, lead and porcelain valves.
- ✓ Absolute control of valve opening and closing under all conditions.
- ✓ Positions valve in relation to other valves.
- ✓ Ample strength characteristics.
- ✓ Indoor or outdoor installation without removing valve from service.
- ✓ Fully mechanical. No electric circuit.
- ✓ Position indicator (not shown) shows valve open or closed.
- ✓ Adjustable compensation for valve wear.

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Book Reviews

● **Dictionary of Engineering and Machine Shop Terms,** *by A. H. Sandy. Chemical Publishing Company, 234 King St., Brooklyn 31, New York. Pages, 153. Price, $2.75.*

Into this volume have been condensed the definitions of a number of the important terms and words with shades of meaning that are peculiar to the engineering world. The author has gathered, through many years of experience both in the industry and as a lecturer, the words and terms in the book. The dictionary will fill a long-felt need of engineers for a clear, concise and thorough research volume defining the terms peculiar to its own world.

● **Bibliography on Secondary Recovery.** *Reprinted from Proceedings, American Petroleum Institute, 24th annual meeting. Production Bulletin No. 230, section 4, 50 West 50th St., New York, N. Y.*

Arranged chronologically in four sections, this is an accurate up-to-date bibliography covering everything ever written on the subject of secondary recovery. Authorities have called it the most comprehensive and complete bibliography that has yet been published. The name of the author or authors, title of the article in a journal or the title of the book, the name of the journal, page numbers, and date are given. In most cases the auspices under which a paper has been presented is indicated. Great care has been taken to eliminate duplication of reference to an article. When possible full information is included on articles that have appeared in more than one publication.

Chicago Bridge president dies

George T. Horton, president of Chicago Bridge & Iron Company, died suddenly March 19. Horton had been associated with the company, founded by his father, Horace E. Horton, since he was graduated from R. P. I. in 1893 and served as its president since his father's death in 1912.

Horton was noted as an engineer and many of the company's designs were developed by him. He served as an alumni trustee of R. P. I. from 1925 to 1928 and had been a life trustee since 1929. He was an honorary member of the Western Society of Engineers and the Chicago Engineers Club and participated in the activities of the American Welding Society, serving as its president in 1939-40. Other engineering affiliations include American Society of Civil Engineers, American Society for Testing Materials, Society of Naval Architects and Marine Engineers, American Petroleum Institute, and Engineers Club of New York.

International Division office

New York offices for A. O. Smith Corporation's International Division have been opened in the Commerce Building, New York, with A. E. Cripps, newly-appointed eastern supervisor, in charge.

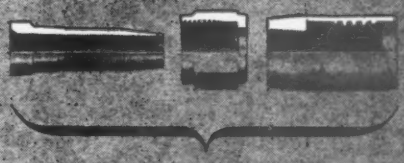
In addition to handling the firm's export activities in New York, Cripps also will supervise its lend-lease and foreign government business in Washington, according to W. H. Porth, International Division manager.

Cripps was born in England, attended King's College and London University, and was a captain in the Royal Flying Corps in World War I. He came to the United States in 1919, became a citizen in 1928, and has been associated with the American Smelting and Refining Company, Black and Decker, and was foreign manager of John A. Roebling's Sons Company for 13 years.

TWO MAJOR WAR DEVELOPMENTS

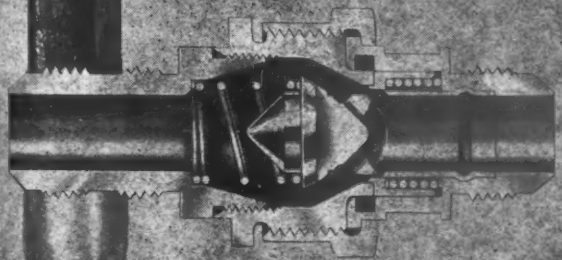
now ready for industry

1. Aeroquip Hose Lines* with detachable and reusable fittings simplify the supply problem and save valuable time, thus helping our armed forces on all fronts.



3 PIECES (each replaceable)

Assembly without special tools. No tightening or adjustment after assembly. Fittings can be removed from hose and reused over 100 times.



2. Aeroquip Self Sealing Couplings* allow disconnection of liquid carrying lines without loss of fluid and reconnection without inclusion of air.

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UNCONDITIONAL GUARANTEE
If this Housing ever Breaks or Distorts we will replace it Free
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Heavy-Duty Pipe Wrench

● It looks different—but the real difference is in its performance. The housing simply won't break or warp—no bother or expense of repairs. Full-floating hookjaw (with handy pipe scale) and replaceable heeljaw take hold instantly, won't lock on pipe. Adjusting nut in open housing spins to pipe size. Powerful comfort-grip I-beam handle eases hard pulls. Ask your Supply House for the rugged work-saver RIGID. We're manufacturing more of them than ever, but it's not enough—please be patient.

Strap Wrench, pipe to 5".

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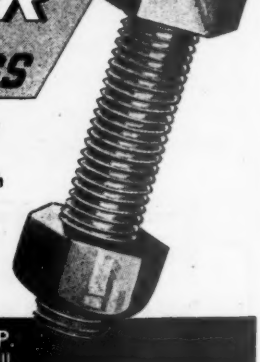

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International Harvester changes

M. F. Holahan, after 50 years with International Harvester Company and one of its predecessor companies, has ended his services as first vice president, it was announced by Fowler McCormick, president, following the meeting of the board of directors. Holahan will remain a member of the board of directors, and will be available to the management in a consulting capacity.

J. L. McCaffrey, former second vice president, will succeed Holahan as first vice president. McCaffrey, also a member of the board of directors, is a former vice president in charge of sales.

W. E. Worth, former vice president in charge of supply and inventory, has been elected second vice president to succeed McCaffrey.

Four other changes in the officer group of the Harvester company were announced by McCormick.

Mercer Lee, former assistant to the vice president, has been elected vice president, and will be in charge of supply and inventory.

Peter V. Moulder, general manager of the motor truck division, R. P. Messenger, general manager of the farm implement division, and Ralph C. Archer, general manager of the farm tractor division, have been elected vice presidents. They will continue as executive heads of their respective divisions.

H. J. Kinkade promoted by Young

H. J. Kinkade

Young Radiator Company, Racine, Wisconsin, announces that H. J. Kinkade is now a member of the Young contract products division staff. In this new connection Kinkade will handle special work on evaporative cooling and similar type equipment for large engine installations. He is especially equipped for this work both by education and experience.

Since acquiring his B. S. degree in mechanical engineering from the University of Missouri in 1925, Kinkade has been prominently associated with the heat transfer industry in both air conditioning and on large internal-combustion engine cooling installations. He was formerly manager of evaporative cooler sales for Fairbanks, Morse and Company, Chicago.

Harry Powell dies

Harry O. Powell, widely known in the petroleum industry, and a foremost authority on oil country tubular goods, passed away at his home in Fort Worth, Texas, on February 26, after a brief illness.

Powell was vice president and manager of tubular sales, Mid-Continent Supply Company, general offices, Mid-Continent Building, Fort Worth, Texas.

Manager Mid-Continent sales

C. M. Powell has been appointed Mid-Continent sales manager of International Derrick and Equipment Company, one of the Dresser Industries, it is announced by Ferguson Barnes, Ideco general manager of sales.

C. M. Powell

Powell, formerly manager of Mid-Continent oil field equipment sales, will be located at Dallas, the company's Mid-Continent headquarters.

A native Texan, Powell is well-known in the producing industry, having been interested in oil field equipment since World War I, and closely associated with the development of many of the early boom fields in Texas. Previously with Bridgeport Machine Company and Black, Sivalls, and Bryson, Inc., Powell joined Ideco in 1925 as district sales manager of Oklahoma, later assuming charge of sales in the Oklahoma, Kansas, Illinois, and Indiana division, and then being transferred to Dallas.

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